EXHIBIT 1

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

GREEN REVOLUTION COOLING, INC.,
Petitioner

v.

MIDAS GREEN TECHNOLOGIES, LLC,
Patent Owner.

Patent No. 10,405,457 to Boyd, et al.

IPR Case No.: IPR2025-00196

PETITION FOR *INTER PARTES* REVIEW OF CLAIMS 1-16 OF U.S. PATENT 10,405,457

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1018	D. Bouris & G. Bergeles, "Particle-Surface Interactions in Heat Exchanger Fouling," Journal of Fluids Engineering, Vol. 118, pp. 574-581 (1996) ASME Fluids Engineering Division
1019	Sandu & D. Lund, "Minimizing Fouling in Heat Exchanger Design," Biotechnology Progress, Vol. 1, No. 1, pp. 10-17 (1985)
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1022	A. Royne & C.J. Dey, "Effect of nozzle geometry on pressure drop and heat transfer in submerged jet arrays," Int'l Journal of Heat and Mass Transfer, Vol. 49, pp. 800-804 (2006)

I. Introduction

Green Revolution Cooling, Inc. ("Petitioner" or "GRC") hereby seeks *inter partes* review of claims 1-16 (the "Challenged Claims") of U.S. Patent No. 10,405,457 (Ex-1001, the "'457 patent").

II. Mandatory Notices Under 37 C.F.R. §42.8(A)(1)

A. Real Party-in-Interest Under 37 C.F.R. §42.8(b)(1)

Petitioner certifies that the real party-in-interest is Green Revolution Cooling, Inc.

B. Related Matters Under 37 C.F.R. §42.8(b)(2)

The '457 patent is currently the subject of pending litigation involving Petitioner: *Midas Green Technologies, LLC v. Green Revolution Cooling, Inc.*, 6-24-cv-00166 (WDTX), filed on March 29, 2024 (the "WDTX Litigation").[1] Petitioner is also aware of the following additional matters involving the '457 patent:

- *Inter Partes* Review No. IPR2021-01176, filed June 23, 2021 (Institution Denied January 6, 2022, solely on *Fintiv* grounds);[2]
- *Midas Green Technologies, LLC v. Rhodium Enterprises, Inc. et al.*, 6-22-cv-00050 (WDTX), filed January 13, 2022; and

[1] GRC was not served the complaint until April 23, 2024.

[2] Petitioner refers to IPR2021-01176 herein as "the Prior IPR."

- *Midas Green Technologies, LLC v. Immersion Systems LLC*, 4-20-cv-00555 (NDTX), filed May 29, 2020 (dismissed in 2022).

Petitioner is unaware of any other judicial or administrative matter that would affect, or be affected by, a decision in the instant proceeding.

C. Lead and Back-up Counsel Under 37 C.F.R. §42.8(b)(3) and Service Information under 37 C.F.R. §42.8(b)(4)

Petitioner designates the following lead and backup counsel:

Lead Counsel	**Back-up Counsel**
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Service on Petitioner may be made by mail or hand delivery to: Greenberg Traurig, LLP, 1144 15th St., Suite 3300, Denver, CO 80202. Petitioner also consents to and prefers electronic service by emailing GRC-IPRs@gtlaw.com and counsel of record.

III. Word Count

Petitioner certifies this Petition is 13,307 words, as counted by the word-processing program (Microsoft Word for Office 365) used to generate this Petition (excluding the table of contents, table of authorities, mandatory notices, certificate of service, and this certificate). This Petition complies with the 14,000 word limit (37 C.F.R. §42.24(a)(1)(i)).

IV. IPR Eligibility and Fees

Petitioner certifies under (37 C.F.R. §42.104) that the '457 patent is available for IPR and Petitioner is not barred or estopped from requesting cancellation of the Challenged Claims identified below.

Ground	'457 Patent Claim	Basis
Ground 1	1-16	Obvious in view of Best-2008 (Ex-1004), and Osada (Ex-1005)
Ground 2	1-16	Obvious in view of Best-2008 (Ex-1004), Osada (Ex-1005), and Best-2012 (Ex-1006)

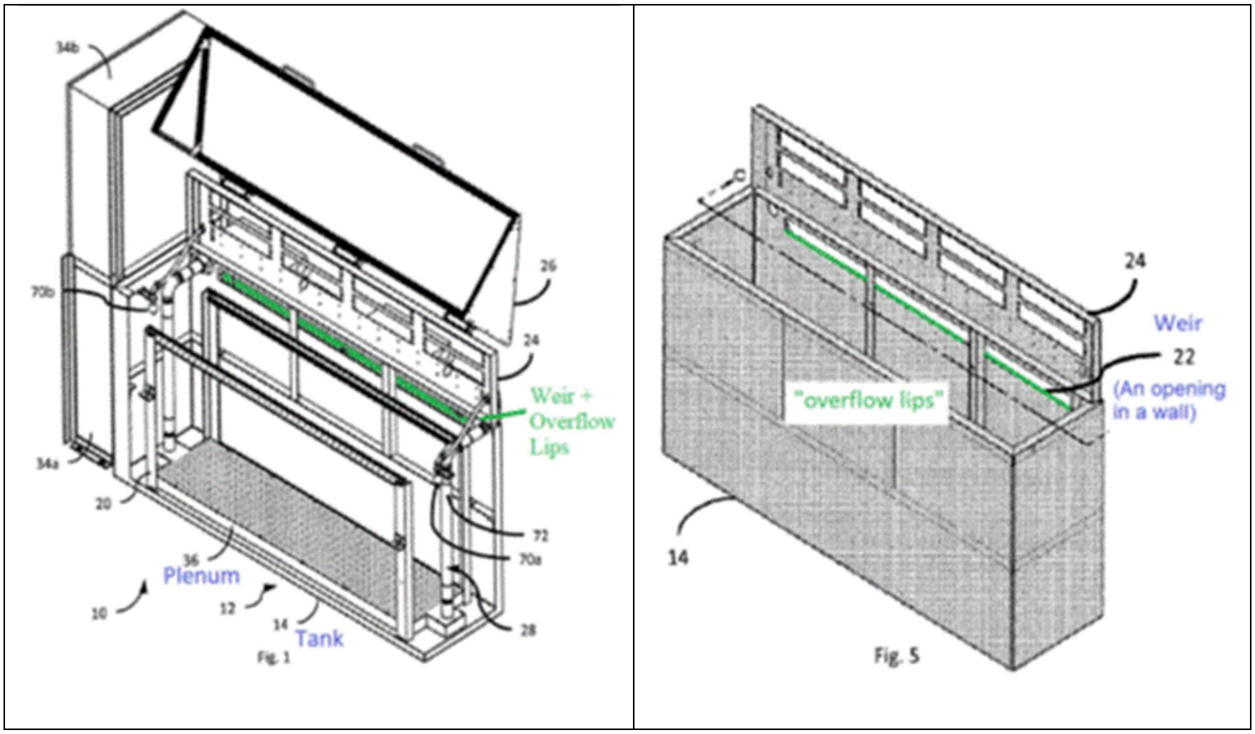
The IPR Petition fee and any necessary additional fees may be charged to Deposit Account No. 50-2638.

V. The '457 Patent

A. General Overview

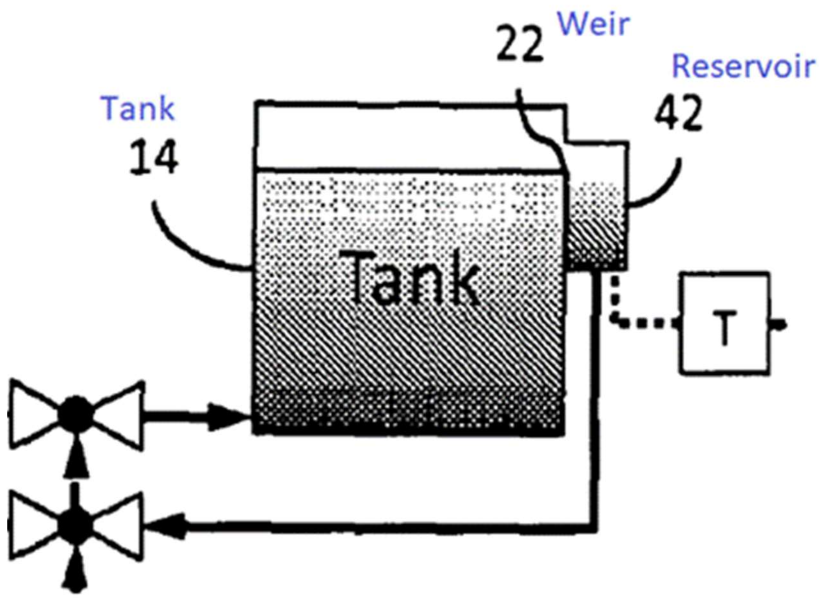
The '457 patent generally relates to "electrical appliance cooling systems, and, in particular, to an improved appliance immersion cooling system and method

of operation." (Ex-1001 at 1:21-24.) As illustrated in FIGS. 1 and 5, the cooling systems can include a tank (14), a plenum (36), and a weir (22) having an overflow lip. (*Id.* at 3:39-56; 4:15-17, 4:27-32.)



(Ex-1001 at FIGS. 1, 5, 13.)[3] An external reservoir (42; FIGS. 3, 13 (below) captures the coolant exiting the weir (22) and recycles it back to the plenum (36) after it is cooled in heat exchangers (32a, 32b) of a primary circulation facility (28). (Ex-1001 at 4:27-32; 4:50-62.)

[3] Annotations and emphasis herein is Petitioner's unless otherwise indicated.



(Ex-1001 at FIG. 13 (partial view).)

As the '457 patent recognizes, prior technology, such as Best-2008, already addressed the immersion cooling of appliances (e.g., computer servers). (*Id.* at 2:23-38.)[4] The '457 patent admits that Best-2008 discloses:

- An appliance immersion tank;
- The tank having several appliance slots for receiving appliances;

[4] The '457 patent includes several self-serving (and incorrect) statements regarding Best-2008, as shown herein. This is unsurprising as Patent Owner was a customer of Petitioner and based its patent filing on the inventive activities of Mr. Best. (*See* Ex-1012-Answer, ¶¶81-91; Ex-1013 (showing embodiment of Best-2008 installed at Midas Networks as of March 2011).)

- Using dielectric fluid for cooling the appliances; and
- Apparatus for cooling the dielectric fluid. (*Id.*)

The ’457 patent purports to have invented a new coolant recirculation loop as compared to Best-2008, but that is incorrect. Instead, as shown herein, the ’457 patent merely adds a conventional weir to a known immersion tank. (Ex-1003-Dahm at ¶¶47-54.)

B. Effective Filing Date

The ’457 patent claims priority to two provisional patent applications, the earliest of which (“the first provisional”) was filed December 14, 2012. (Ex-1001, (60).) Petitioner applies this date herein without conceding the ’457 patent is entitled to claim priority thereto.

Petitioner notes that both the second provisional and the PCT application corresponding to the ’457 patent were filed after the AIA took effect. Thus, if the first provisional fails to provide support for any claim of the ’457 patent, then all claims of the ’457 patent are subject to the AIA versions of §§102-103. *SNIPR Tech. Ltd. v. Rockefeller Univ*, 72 F.4th 1372, 1376 (Fed. Cir. 2023) (explaining AIA provisions 3(n)(1)-(2), which provides that “patents and applications that contain (*or contained **at any time***) at least one claim with a pre-AIA effective filing date *and at least one claim with a post-AIA effective filing date are subject to the patentability requirements in the AIA versions of 35 U.S.C. §§102-103*.”).

Notably, the ’457 patent describes how its content extends beyond that of the provisional applications. (Ex-1001 at 6:37-7:27, 8:57-65 (first provisional); 7:28-39 (second provisional).) The ’457 patent also appears to admit that the “dielectric fluid recovery reservoir” of independent claims 1 and 6 was *not* disclosed in its first provisional application:

> “Further, our placement of the reservoir 42 outside of (but immediately adjacent to) the tank 14 tends to reduce the total volume of the dielectric fluid (***as opposed to the alternative arrangement we proposed in our First Provisional**, wherein a recovery trough was disposed within the tank 14*); then, we positioned the components comprising the primary circulation sub-facilities 28 so as to be vertically beneath the footprint of the reservoir 42.” (Ex-1001 at 8:57-65.)

Thus, Patent Owner appears to admit its claims are subject to the AIA and otherwise not entitled to the benefit of at least the first provisional filing date.

C. Prosecution History

The ’457 patent is one of two issued U.S. patents in this family. The file histories of both patents are analyzed below.

1. Prosecution of the ’457 patent

The claims of the ’457 patent were subject to minimal prosecution, receiving only three office actions, the third of which improperly contended a Japanese patent

application was prior art. (Ex-1002 at 531-541; 549.) Thus, the '457 patent only received two actions involving prior art.

In the first action, the Examiner rejected all claims based on Best-2008 alone (US2011/0132579; Ex-1004) or Best-2008 in combination with Pfahnl (US2006/0126292). (Ex-1002 at 406-413.)

In response, Applicant argued that both Best-2008 and Pfhanl failed to disclose the plenum and weir limitation of the claims, but nonetheless amended the independent claims to require "a weir… <u>having an overflow lip</u>." (*Id.* at 422-428.)

The Examiner was unpersuaded and again rejected the claims based on Best-2008 and Pfhanl. (*Id.* at 432-438.) Importantly, the Examiner:

> (a) disagreed that Best-2008 failed to disclose the claimed plenum ("[t]he plenum is defined by the walls and bottom of the tank and the bottom surfaces of the devices 120. In the optionally presented 103 rejection, the plenum is also structurally defined by the piece forming openings 122 in the bottom portion 110");
>
> (b) contended that "the phrase 'adjacent all appliance slots', as presently claimed modifies 'the long wall of the tank' and not the weir;" and
>
> (c) pointed out that, "as far as the 'weir' structure is defined in the disclosure it merely amounts to an opening in a wall and its 'lip' is never defined as more than the bottom surface of that opening." (*Id.* at 437-38.)

The Examiner thus requested:

> "If the applicant believes that there is further structural limitation that should be associated with the term weir, he is requested to point out where the disclosure supports that in any further communications." (*Id.* at 438.)

Applicant never did so. Instead, Applicant argued that Best-2008 and Pfhanl were not combinable because Pfanhl used air as its dielectric coolant whereas Best-2008 used a liquid. (*Id.* at 467-475.) Applicant also amended claims 1 and 6 to require an external reservoir to receive the dielectric fluid from the weir and argued both Best-2008 and Pfhanl failed to disclose this requirement. (*Id.*) Applicant also added a new claim set (claims 11-16) from a European counterpart. (*Id.*)

The Examiner then issued a third action, which erroneously cited a later-filed Japanese patent. (*Id.* at 531-541.) The Examiner recognized the error and allowed the application without further discussion. (*Id.* at 543-550.)

2. Prosecution of the '446 patent

U.S. Patent No. 10,820,446 ("the '446 patent") is a continuation of the '457 patent. (Ex-1008, (63).) The '446 patent received a single office action, which was a double-patenting rejection over the '457 patent. (Ex-1007 at 80-85.) Applicant filed a terminal disclaimer (*id.* at 66-76) after which a notice of allowance issued (*id.* at 97-101).

D. The Challenged Claims

Petitioner challenges claims 1-16, of which claims 1, 6, and 11 are independent. As shown in §X.B.2 and Ex-1009, the independent and dependent claims of the three claims sets are highly similar.

VI. Discretionary Denial is Unwarranted

A. 35 U.S.C. §314(a) Does Not Favor Denial

The '457 patent is asserted against Petitioner in the WDTX litigation. Discretionary denial is inappropriate under the factors articulated in *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (PTAB Mar. 20, 2020) (precedential) (hereinafter "*Fintiv*"). On June 21, 2022, the USPTO issued updated guidance and expressly noted that the PTAB will not discretionarily deny institution when, as here, Petitioner presents a *Sotera* stipulation. *Sotera Wireless, Inc. v. Masimo Corp.*, IPR2020-01019, Paper 12 (PTAB Dec. 1, 2020) (precedential); Memorandum: Interim Procedure for Discretionary Denials in AIA Post-Grant Proceedings with Parallel District Court Litigation (USPTO June 21, 2022) ("USPTO *Sotera* Guidance"). For this reason alone, the Board should not discretionarily deny this petition.

The *Fintiv* factors also favor institution. Factor 1 (stay) is neutral because Petitioner has not yet moved for a stay. *Hulu LLC v. SITO Mobile R&D IP, LLC*, IPR2021-00298, Paper 11 at 10-11 (PTAB May 19, 2021).

Factor 2 (proximity) is also neutral. A trial date is tentatively scheduled for February 2, 2026, but this date is likely to be postponed.[5] (Ex-1014 at 5.) With this petition filed in November 2024, a final written decision may be expected by May 2026, i.e., only three months after the scheduled trial date. The Board routinely grants institution where a FWD may issue shortly after a potential trial date, and has relied on various justifications, such as diligence in filing the petition, a stipulation not to pursue the asserted grounds in litigation, minimal investment in litigation, and the merits of the invalidity challenge. *Verizon Bus. Networks Services, Inc. v. Huawei Techs. Co.*, IPR202-01141, Paper 12 (PTAB Jan. 14, 2021). The same factors are present here as Petitioner diligently filed this petition well in advance of the one-year bar date and within approximately three months of the Patent Owner's infringement contentions in the district court litigation. (Ex-1014 at 1; Ex-1011.) Non-claim construction fact discovery does not open until February 2025 and expert discovery does not begin until September 2025. (Ex-1014 at 3-4.) A *Markman* hearing is scheduled for February 3, 2025. (Ex-1014 at 3.)

Factor 3 (investment) weighs against discretionary denial. The district court case is in the early stages. Fact and expert discovery are not open and *Markman*

[5] The median date to trial from case filing in WDTX is currently 853 days (Ex-1015) yet trial was scheduled for less than 2 years (730 days) (Ex-1014 at 5).

briefing has not begun. (Ex-1014 at 3.) Where, as here, "the district court has not issued orders related to the patent at issue in the petition, this fact weighs against exercising discretion to deny institution" *See Fintiv* at 10.

Factor 4 (overlap) weighs against discretionary denial. Petitioner has voluntarily stipulated "that if the PTAB institutes IPR2024-00196, GRC agrees not to pursue any grounds raised in the petition, or any grounds GRC could have reasonably raised in the petition, in [the] district court litigation or any parallel proceeding." (Ex-1016.) Such a broad stipulation weighs "strongly in favor of not exercising discretion to deny institution under 35 U.S.C. § 314(a)," and is dispositive in view of the USPTO *Sotera* Guidance. *Sotera Wireless*, IPR2020-01019, Paper 12 at 19; USPTO *Sotera* Guidance.

Factor 5 (same parties) is neutral as the parties here are the same as in the Litigation. *Snap, Inc. v. SKR Technology LLC*, IPR2020-00820, Paper 15 (PTAB Oct. 21, 2020).

Factor 6 (merits) weighs against discretionary denial. Regardless of the discretionary denial factors, the compelling merits of the challenge presented herein warrant institution. As demonstrated by the Petition, the challenged claims are unpatentable over two grounds involving Best-2008, Osada, and Best-2012—combinations of which were not considered during prosecution. This is also the only

petition challenging the ’457 patent. Thus, a determination of its validity by the Board would conserve resources.

B. 35 U.S.C. §325(d) Does Not Favor Denial

This Petition relies on Best-2008, which was cited by the Examiner during prosecution of the ’457 patent. Petitioner’s reliance on Best-2008 implicates the two-part framework of *Advanced Bionics, LLC v. Med-El Elektromedizinische Geräte GmbH*, IPR2019-01469, Paper 6 at 8 (PTAB Feb. 13, 2020) (precedential). Under this framework, discretionary denial is unwarranted.

1. *Advanced Bionics* Step 1

Step 1 considers several non-exclusive factors set forth in *Becton, Dickinson & Co. v. B. Braun Melsungen AG* IPR2017-01586, Paper 8 (PTAB Dec. 15, 2017) (precedential as to Section III.C.5, first paragraph) (informative) (hereinafter “*Becton*”), namely factors (a), (b), and (d).

Factors (a)-(b)

The first two factors for Step 1 are:

> (a) the similarities and material differences between the asserted art and the prior art involved during examination;

(b) the cumulative nature of the asserted art and the prior art evaluated during examination.[6]

These factors favor Petitioner. While Best-2008 was discussed during prosecution, the Examiner never considered the Osada reference (Ex-1001, pp. 1-2), which specifically teaches, *inter alia*, the recovery reservoir limitation the Examiner believed to be missing from the prior art. (*See* Ground 1.) The Examiner also never considered the Best-2012 reference, which supplements the teachings of Best-2008.

The '457 patent claims are not inventive over the new combinations of prior art detailed herein. In the Prior IPR and during prosecution, Patent Owner generally did not dispute that Best-2008 disclosed the majority of claim limitations. Patent Owner argued that Best-2008 lacks the claimed weir and its corresponding external recovery reservoir. (1010 at 4-5; Ex-1002 at 467-475.) As detailed herein, those claim limitations are obvious over of Best-2008 in view of Osada, and over Best-2008 in view of Best-2012 and Osada.

Accordingly, Petitioner presents new arguments and art not previously raised during examination.

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[6] *VMWare, Inc. v. Intellectual Ventures II LLC*, IPR2020-00859, Paper 13 at 18-19 (PTAB Nov. 13, 2020) (citing *Becton*).

Factor (d)

Step 1, factor (d) is:

> (d) the extent of the overlap between the arguments made during examination and the manner in which petitioner relies on the prior art.[7]

Factor (d) also favors Petitioner. Grounds 1 and 2 were not considered by the Office. Regarding "arguments made [by the Office] during examination," the Examiner found that nearly all claim limitations were disclosed by Best-2008, prior to the final amendment made by Patent Owner during prosecution. As for "arguments made [by the applicant] during prosecution," there is minimal overlap between the material issues in this Petition and Applicant's arguments. Indeed, instead of "pointing out" what disclosure in the '457 patent supports "further structural limitation…associated with the term weir," (Ex-1002 at 438), Patent Owner amended the claims to require "a dielectric fluid recovery reservoir positioned vertically beneath the overflow lip of the weir and adapted to receive the dielectric fluid as it flows over the weir" ("the dielectric reservoir" limitation), and argued that the cited references failed to disclose this requirement. (*Id.* at 467-475.) The dielectric reservoir limitation is disclosed in Osada. Accordingly, Petitioner's

[7] *VMWare*, IPR2020-00859, Paper 13 at 18-19.

arguments materially differ from the Best-2008 arguments raised by the Examiner or applicant during prosecution.

For at least the above reasons, *Becton* factors (a)-(b) and (d) favor Petitioner—the same or substantially the same art was ***not*** previously presented to the Office and the same or substantially the same arguments were ***not*** previously presented to the Office. *See Snap, Inc. v. SRK Tech., LLC*, IPR2020-00820, Paper 15 at 25-28 (Oct. 21, 2020) (rejecting patentee's argument regarding Step 1 where only one prior art reference in obviousness combinations was previously considered by the Examiner).

2. *Advanced Bionics* Step 2

While Petitioner has shown it is unnecessary to proceed to Step 2 of *Advanced Bionics*, the remaining *Becton* factors (c), (e), and (f) also favor Petitioner.

Factor (c)

Step 2, factor (c) is:

> (c) the extent to which the asserted art was evaluated during examination, including whether the prior art was the basis for rejection.[8]

This factor favors Petitioner because Osada and Best-2012 were never before the Examiner. The Examiner did cite Best-2008, finding that it disclosed the

[8] *VMWare*, IPR2020-00859, Paper 13 at 18-19.

limitations of the claims other than "the dielectric reservoir" limitation added in the final amendment, which Osada discloses. (*See* §V.C.)

Factor (e)

Step 2, factor (e) is:

> (e) whether Petitioner has pointed out sufficiently how the Examiner erred in its evaluation of the asserted prior art.[9]

This factor favors Petitioner. While Petitioner generally agrees with the Examiner's application of Best-2008, the examiner should have located prior art disclosing "the dielectric reservoir" limitation that was allegedly missing from Best-2008. Indeed, such external reservoirs were known, and were even characterized as being "conventional" and "widely-used." (Ex-1005-Osada at 0006; FIG. 16A.) Accordingly Petitioner presents new obviousness combinations relying on art that was neither cited nor discussed during prosecution. Moreover, the prior art shows that "the dielectric reservoir" limitation was known and in the context of liquid immersion tanks, such as those described by Best-2008. (*See* Grounds 1-2.)

Factor (f)

Step 2, factor (f) is:

[9] *VMWare*, IPR2020-00859, Paper 13 at 18-19.

(f) the extent to which additional evidence and facts presented in the Petition warrant reconsideration of the prior art or arguments.[10]

This factor favors Petitioner. Petitioner relies on prior art that was not cited or considered by the Examiner during prosecution. Petitioner also relies on expert testimony from Dr. Dahm that was not previously considered, which establishes that a POSITA would have been motivated to combine the references at issue in Grounds 1 and 2 in ways that render all Challenged Claim obvious. This evidence was not considered by the Examiner and would have overcome any arguments raised by applicant during prosecution.

In sum, this Petition relies on new facts and evidence that the Examiner did not consider during prosecution. Thus, under *Advanced Bionics* discretionary denial is inappropriate.

VII. Person of Ordinary Skill in the Art ("POSITA")

A POSITA in the field of the '457 patent at the time of the earliest possible effective filing date (December 14, 2012) would have had Bachelor of Science degree in mechanical or chemical engineering and at least two years of experience relating to the design and/or implementation of fluid circulation systems involving application of fluid dynamics and heat transfer principles. Additional education may

[10] *VMWare*, IPR2020-00859, Paper 13 at 18-19.

serve as a substitute for a lack of experience and vice versa. (Ex-1003-Dahm at ¶¶36-41, 63-70.)

VIII. Claim Construction

A. Plain Meaning Should Apply

Petitioner does not believe any formal claim constructions are required and thus construes the claims at issue in accordance with their ordinary and customary meanings. 37 C.F.R. §41.100(b). Nonetheless, for purpose of completeness, Petitioner provides the following background on certain terms that were previously construed and/or characterized in prior proceedings.

B. Prior Litigation Constructions (weir, plenum)

In a prior litigation, Patent Owner and a defendant (Immersion Systems LLC) agreed to the below definitions of weir and plenum:

Claim Term (and where found)	Construction
"weir" (claims 1, 5, 6, 10, 11, 14)	an overflow structure or barrier that determines the level of a liquid
"plenum" (claims 1, 5, 6, 10, 11, 14)	a structure for dispensing liquid

(Ex-1010 at 26.) Petitioner takes no position on these contructions as the prior art cited herein teaches a weir and a plenum under any reasonable construction. (Ex-1003-Dahm at ¶¶81-82.)

C. "a weir, integrated into the long wall of the tank adjacent all appliance slots,"

As noted previously, during prosecution the Examiner contended that "the phrase 'adjacent all appliance slots', modifies 'the long wall of the tank' and not the weir" (Ex-1002 at 437) in relation to the limitation:

> "*a weir*, integrated horizontally into *the long wall of the tank adjacent all appliance slots*."

Applicant did not dispute the Examiner's contention. However, in the Prior IPR, Patent Owner argued:

> "The specification emphasizes the preferential goal of "substantially equal flow of the dielectric fluid upwardly into each appliance slot." … To that end, in a preferred embodiment, a long, open weir (22) is "integrated into the long rear wall of the tank." … *The weir (22) extends to substantially the entire length of the tank, adjacent all the appliance slots*. This arrangement facilitates substantially uniform recovery of the dielectric fluid as it flows through each appliance slot across the length of the tank. … If the weir (22) were not so extended, substantially uniform recovery of the dielectric fluid would not be achieved." (Ex-1010 at 4.)

Thus, Patent Owner contended that the claims required the "weir" to be both (a) "integrated into the long wall of the tank" and (b) "adjacent all appliance slots." Petitioner applies the prior art herein in accordance with Patent Owner's contention from the Prior IPR (i.e., that the weir must extend along the long wall adjacent all

appliance slots), but the result would not change if the Examiner's understanding was correct, i.e., it is the long wall, not the weir, that must be "adjacent all appliance slots," as the prior art renders both configurations obvious. (Ex-1003-Dahm at ¶¶73-75.)

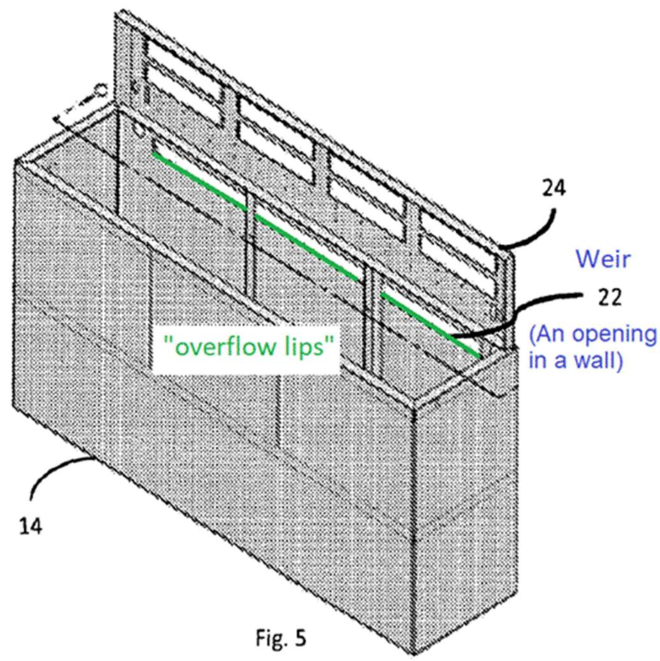
D. "a weir… having an overflow lip"

As explained in §V.C.1., for the limitation "a weir…having an overflow lip," the Examiner contended that the "weir" can be an opening in a wall, a "lip" can be "the bottom surface of [the weir] opening," and the Examiner specifically requested Applicant to "point out where the disclosure" in its specification provides "further structural limitation that should be associated with the term weir." (Ex-1002 at 438.) Applicant never did so.

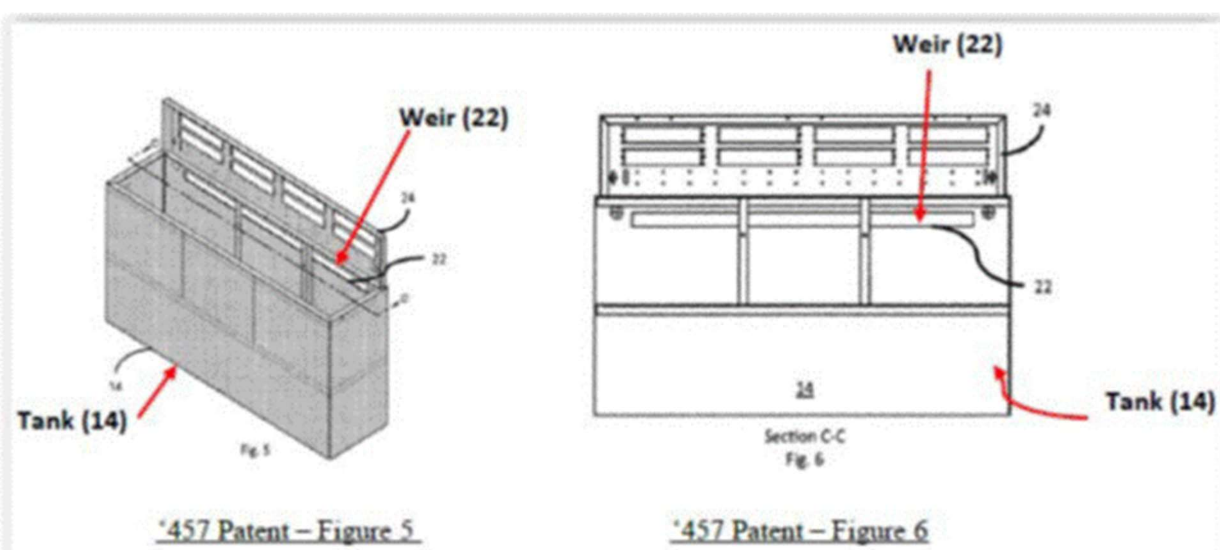
The Examiner was correct. A weir can be an opening in a wall, which meets the definition of "an overflow structure or barrier that determines the level of a liquid," as agreed in the prior litigation. The term "lip" is used once in the specification of the '457 patent:

> "One further shared component is the dielectric fluid recovery facility 40 (FIG. 2) <u>*comprising a dielectric fluid recovery reservoir 42*</u> (see, FIG. 3, FIG. 4 and FIG. 13) <u>*positioned vertically beneath the overflow **lip** of the weir 22*</u> and adapted smoothly to receive the dielectric fluid as it flows over the weir 22[.]" (Ex-1001 at 4:27-32.)

FIG. 5 (annotated below), confirms the Examiner's understanding. Weir (22) is an opening in a wall and the "overflow lips" are merely the bottom surfaces of those openings.



Patent Owner confirmed as much in annotated figure it submitted in the Prior IPR:



(Ex-1010 at 3.) (Ex-1003-Dahm at ¶¶76-80.)

E. "adpated to facilitate substantial uniform recovery"

In the Prior IPR, Patent Owner noted disputes surrounding the limitation "adapted to facilitate substantial uniform recovery." (Ex-1010 at 26-29.) The combination of prior art cited herein disclose this limitation under any reasonable construction. Indeed, all of Best-2008, Osada, and Best-2012 disclose liquid circulation systems that are "adapted to facilitate substantial uniform recovery."

IX. Overview of the Prior Art

A. Best-2008 (Ex-1004; US2011/0132579)

Best-2008 is U.S. Patent Application Publication No. 2011/0132579, which published June 9, 2011 and which claims priority to a PCT Application filed August 10, 2009, and three provisional applications, the earliest of which was filed August 11, 2008. Best-2008 is pre-AIA §102(b) prior art.

Best-2008 discloses, *inter alia*, dielectric cooling tanks for immersion of electronic components (appliances), such as computer servers. (Ex-1004-Best-2008 at FIGS. 3-6; 0083.) Best-2008 uses a dielectric coolant recirculation loop (fluid circuit) to continuously cool the servers, as illustrated in various figures, including FIG. 1A, below:

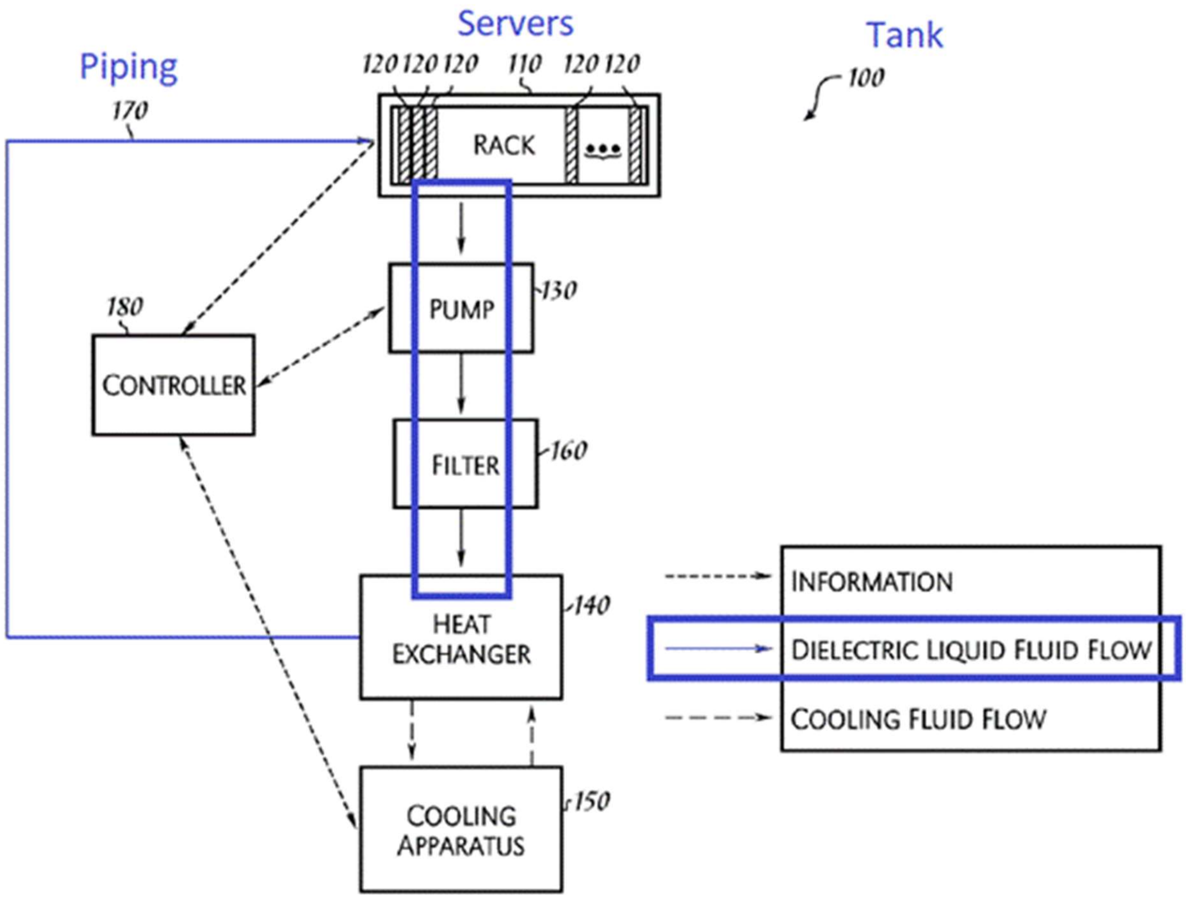


Fig. 1A

(Ex-1004-Best-2008 at FIG. 1A; 0065-67; Ex-1003-Dahm at ¶¶84-86.)

Best-2008 discloses a variety of manners in which to implement its dielectric liquid recirculation loop, including for instance, the use of inlet (440) and outlet (450) pipes in communication with the cooling systems of FIGS. 1A, 1B, and 2.

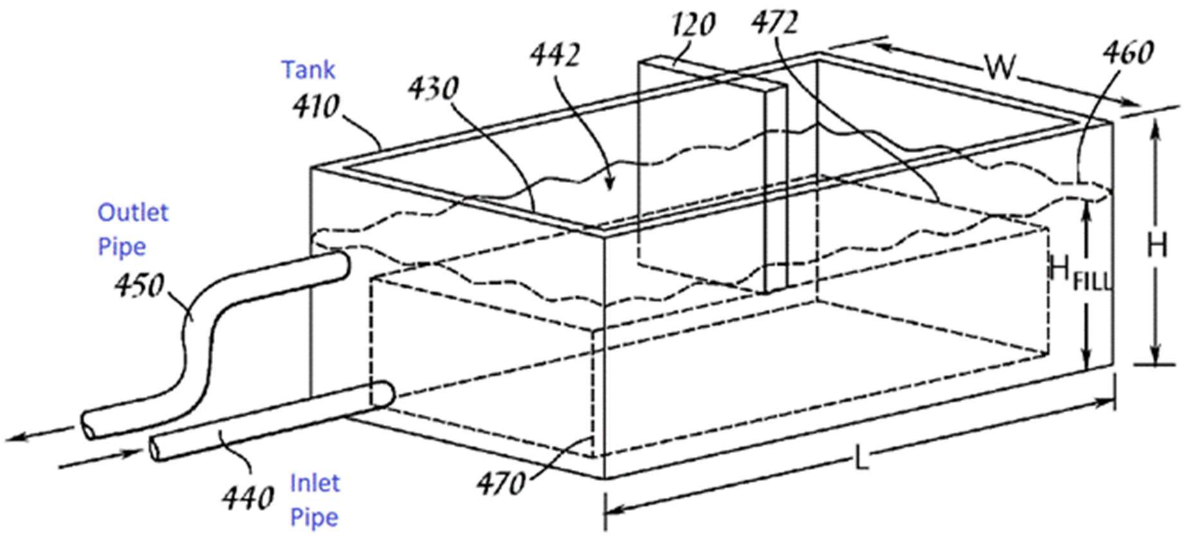


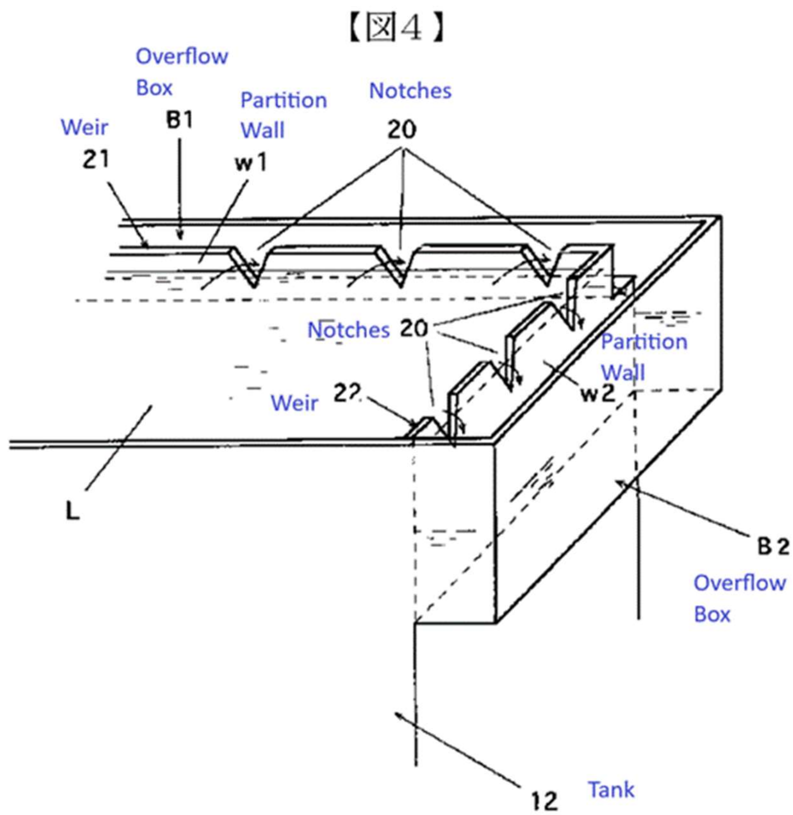
Fig. 3

(Ex-1004-Best-2008 at FIG. 3, 0084; Ex-1003-Dahm at ¶¶87-88.)

Best-2008's tanks are generally open to the atmosphere for ease in removing and adding servers thereto, but the open tanks expose the dielectric liquid to particulates and other materials, requiring filtration. (Ex-1004-Best-2008 at 0069, 0083, 0091-92, 0094, 0097, 0110; Ex-1003-Dahm at ¶89.) Indeed, a POSITA would have recognized that, without filtration, heat transfer from the servers into the dielectric liquid and from the dielectric liquid into the heat exchanger would be materially hindered by particulates and other materials accumulated on the servers and the heat exchanger. (Ex-1003-Dahm at ¶¶101-103, 111-113, 116 (citing Exhibits 1017-1019).) Accordingly, Best-2008 describes and illustrates filtration downstream of the tank and upstream of the heat exchanger. (Ex-1004-Best-2008 at 0081; FIGS. 1A and 2, 0081; Ex-1003-Dahm at ¶89.)

B. Osada (Ex-1005; JP2001-181898)

Osada is a certified English translation of Japanese Patent Application Publication No. 2001/181898, which published on July 3, 2001. Osada is pre-AIA 102(b) prior art. Osada discloses an open top immersion tank system having a recirculation loop similar to that of Best-2008. (Ex-1005-Osada at Abstract, 0002-3, FIGS. 3, 4, 16A.) Osada's open top tank uses a weir to maintain an appropriate liquid level and assist with filtration. (Ex-1003-Dahm at ¶¶90-92.)

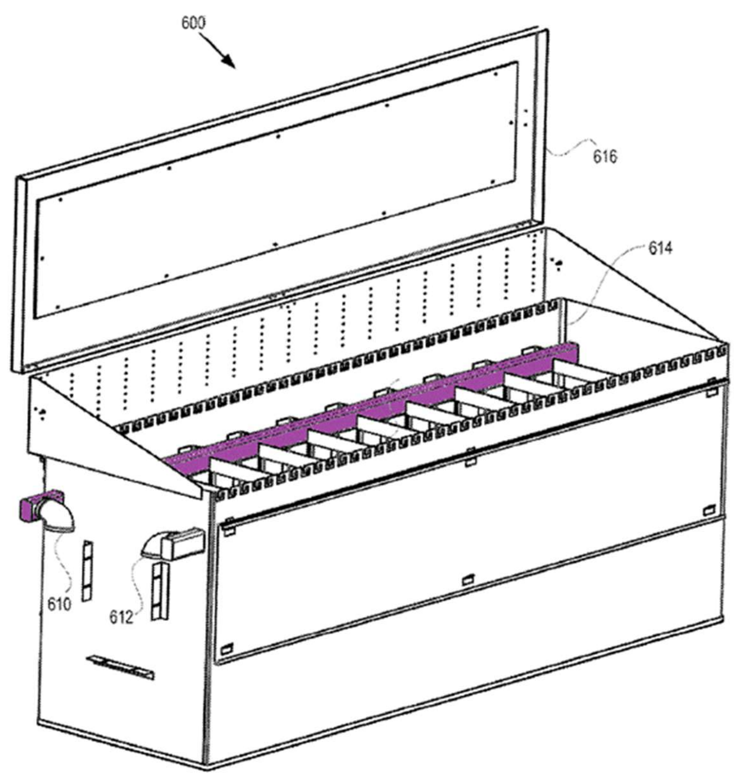


(Ex-1005-Osada at FIG. 4.)

C. Best-2012 (Ex-1006; US2014/0211412)

Best-2012 is U.S. Patent Application Publication No. 2014/0211412, which claims priority to a PCT Application filed August 12, 2012, and a provisional patent application filed August 5, 2011. (Ex-1006-Best-2012, (22), (60).) Best-2012 is pre-AIA §102(e) prior art as of its PCT filing date. Petitioner reserves the right to show it is also prior art as of its provisional application filing date. Both Best-2012 and Best-2008 name Christiaan Scott Best as the first inventor.

Best-2012 discloses several new embodiments relative to Best-2008, including an embodiment in which the dielectric fluid flows through a recirculation loop comprising a suction manifold (purple):



(Ex-1006 at FIG. 6.) The suction manifold extends the entire length of the long wall of the tank to facilitate "coolant flow [that] is approximately equal along the length of the entire tank 600." (Ex-1006-Best-2012 at FIG. 6; 0070; *id.* at 0023, 0037-38, 0069, 0071-73; FIGS. 7a-7b; Ex-1003-Dahm at ¶¶93-96.)

X. <u>GROUND 1</u>: Best-2008 in view of Osada

A. Scope, Content, and Rationale for Combining Prior Art

Ground 1 relies on Best-2008 and Osada. Best-2008 discloses dielectric cooling tanks for immersion of electronic components (appliances), such as computer servers. (Ex-1004-Best-2008 at FIGS. 3-6; 0083.) Best-2008 uses a dielectric coolant recirculation loop (fluid circuit) to continuously cool the servers, as illustrated in various figures, including FIG. 1A, below:

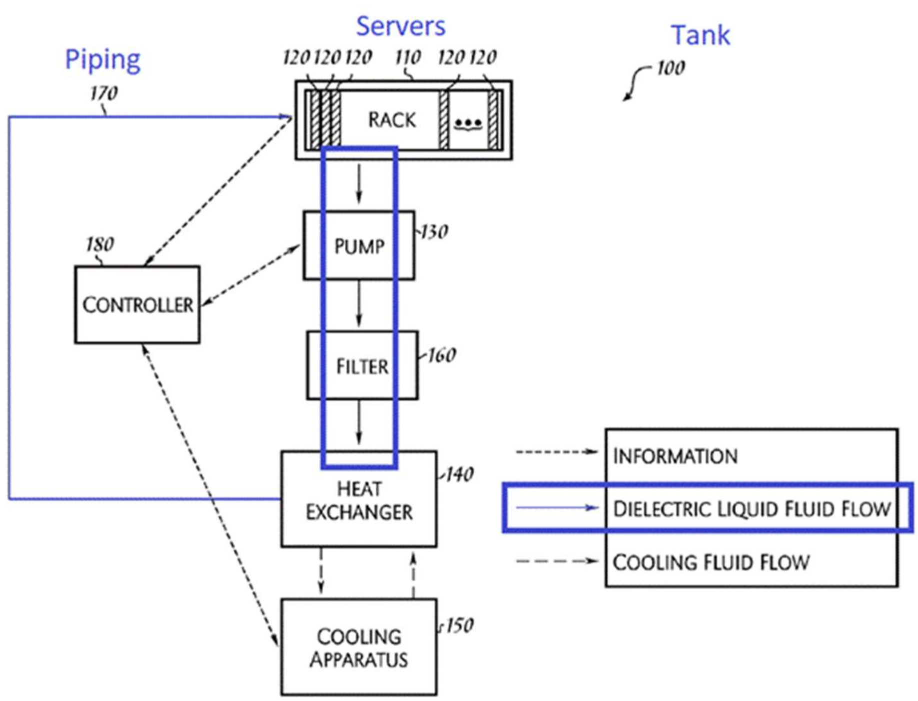


Fig. 1A

(Ex-1004-Best-2008 at FIG. 1A; 0065-67.) As Best-2008 explains, the dielectric liquid heated by its servers is:

> "fluidly coupled through suitable piping or lines to a pump 130, which pumps the heated liquid coolant through suitable piping or lines to a remotely or distally located heat exchanger 140 associated with a heat-rejection or cooling apparatus 150. The distally heat exchanger 140 rejects the heat from the incoming heated liquid coolant and fluidly couples the cooled liquid coolant through a return fluid line or piping 170 back into the tank 110. *Thus, at least a portion of the liquid coolant completes a fluid circuit through the servers 120 in the tank 110, pump 130, heat exchanger 140, and back into the tank 110*." (*Id.* at 0067.)

Best-2008 discloses various dielectric liquid recirculation arrangements, such as the those of FIGS. 3-6, examples of which are illustrated below.

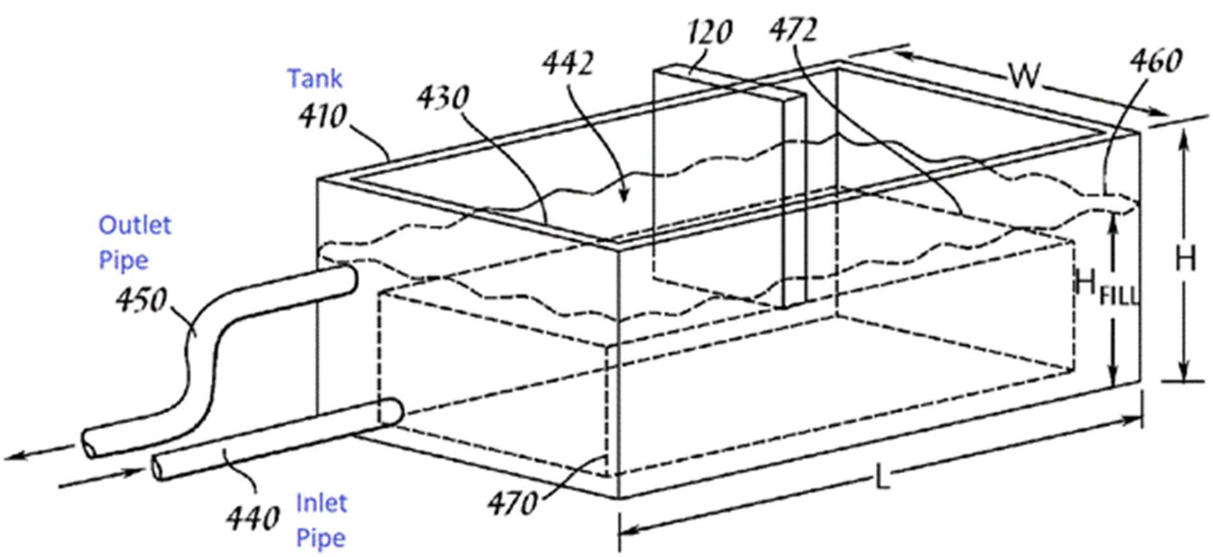


Fig. 3

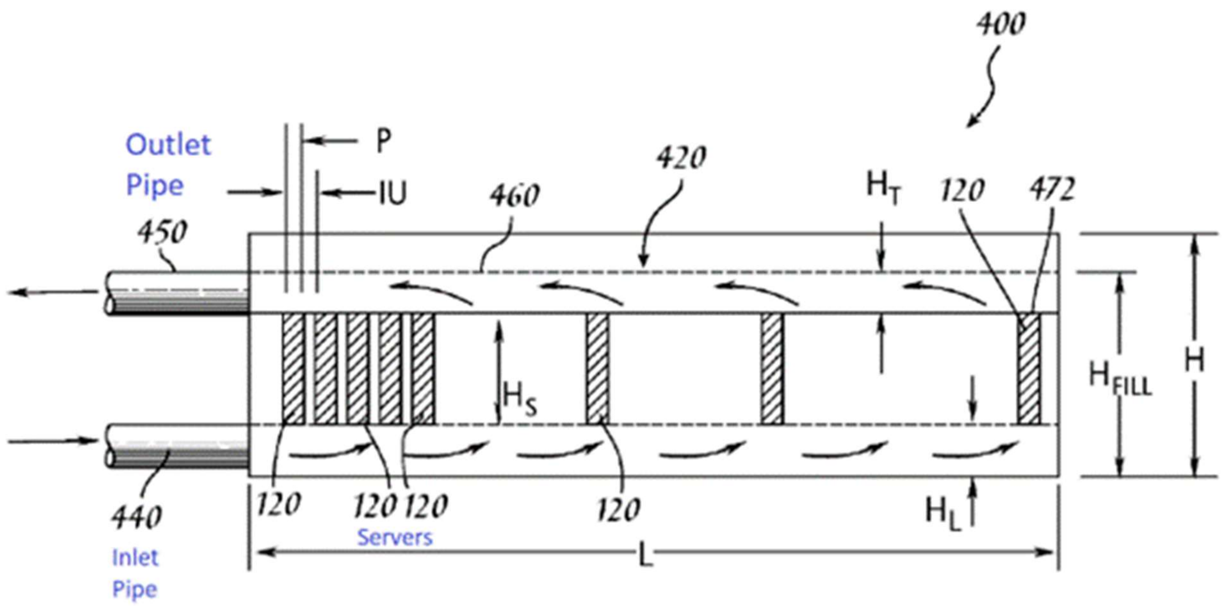


Fig. 6

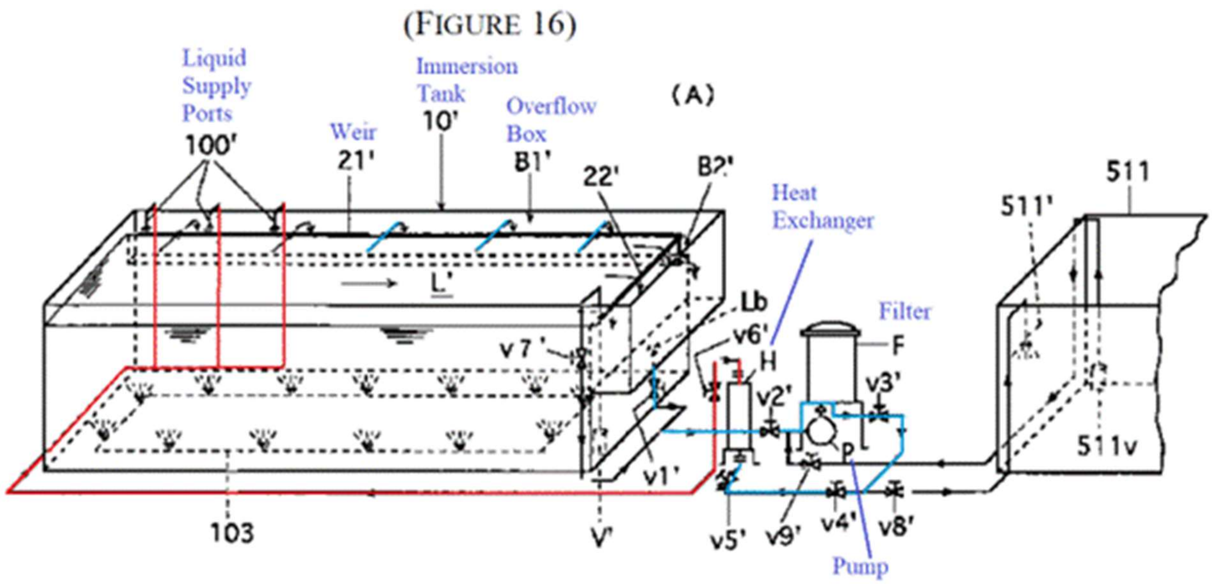
(Ex-1004-Best-2008 at FIGS. 3, 6.) The piping (including inlet (440) and outlet (450)) is connected to a heat exchanger "for the flow of lower temperature or cooled liquid coolant into the tank 410 and … for the flowing or pumping of heated coolant out of the tank to the external heat exchanger." (Ex-1004-Best-2008 at 0084.) The heat-rejection or cooling systems may be any of those "described in connection with FIGS. 1A, 1B, and 2." (*Id.*; Ex-1003-Dahm at ¶¶99, 105-110.)

Best-2008's tanks are generally open to the atmosphere for ease in removing and adding servers thereto, but the open tanks expose the dielectric liquid to particulates and other materials, requiring filtration. (Ex-1004-Best-2008 at 0027-29, 0069, 0080, 0083, 0091-92, 0094, 0097, 0110; Ex-1003-Dahm at ¶¶100-104, 111-114.) Best-2008 does not specifically disclose how its filtration process works, or how its system deals with impurities that contaminate the bath in the open-air tank

110. (Ex-1004-Best-2008 at 0027-29, 0069, 0080, 0083, 0092, 0097, 0114, 0126; Ex-1003-Dahm at ¶¶115-118.) Osada does and in the context of similar open top immersion tanks.

Specifically, Osada relates to liquid immersion tanks "that can be utilized in an article processing device to perform processing using a liquid, and in particular, to an article processing device that involves a liquid for which filtration of the processing liquid is desired." (Ex-1005-Osada at 0001.) Like Best-2008, Osada recognizes important parameters to control include "the liquid quality and liquid composition of said liquid, the volume of processing liquid in the liquid tank, filtration volume, temperature, and the like…." (*Id.* at 0002; Ex-1003-Dahm at ¶121.)

Figure 16(A) of Osada illustrates a "conventional" immersion tank and liquid recirculation system known at the time of Osada. Like Best-2008, the system includes an open-air tank (10), a pump (P), a filter (F), and a heat exchanger (H):

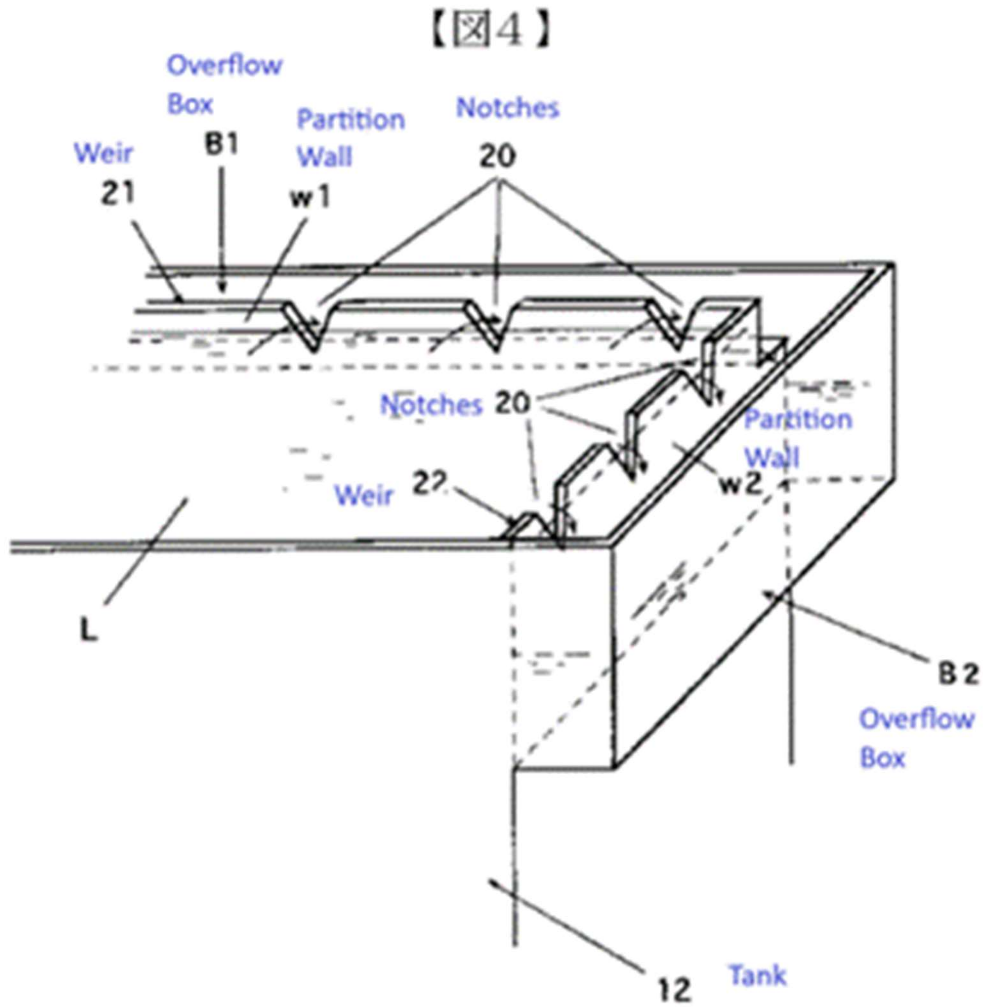


(Ex-1005-Osada at FIG. 16(A); 0050-54.) The liquid (L') in the immersion tank (10') exits via weirs (21'/22'), into overflow boxes (B1'/B2'), then through an exit port (Lb), after which it is pumped through the filter (for impurity control), then through the heat exchanger (for liquid temperature control), and then back into the tank via liquid supply ports (100'). (*Id.*) Thus, Osada employs a nearly identical fluid recirculation loop as that of Best-2008 (i.e., from a tank to an external pump, then through a filter, then a heat exchanger, and then back to the liquid immersion reservoir). (Ex-1003-Dahm at ¶¶122-125.)

Osada discloses that such conventional systems "widely used" a "rectangular weir" that extends "linearly in the horizontal direction" into a "overflow box" located on the outside of the tank for filtration / removal of impurities. (Ex-1005-Osada at 0006.) Osada explains that the conventional weir removes impurities located near the top of the liquid tank, but not impurities suspended in lower layers,

leading to increased impurity concentrations over time. (*Id.* at 0010.) Osada further explains that the conventional weir may be susceptible to backflow into the tank due to a linear increase in flow rate into the overflow boxes. (*Id.* at 0006-7 ("resulting in inflow of the processing liquid into said box without any elevation difference"), 0133, 0137-43.) (Ex-1003-Dahm at ¶126.)

Accordingly, Osada discloses an improved "liquid tank, characterized by having <u>*one, two, or more overflow boxes*</u> in order to force the overflow of impurities that may be suspended in the top layer part in liquid accumulated in the liquid tank along with liquid <u>*from a weir part, in which weir part,* ***an overflow notch*** *is formed in a top margin part of a partition wall between the overflow box and the liquid tank*</u>." (Ex-1005-Osada at 0015.) The use of overflow notches facilitates both (a) removal of "impurities that are more likely to be suspended in the lower layers" to "reduce the amount of impurities remaining in the liquid tank," and (b) "no significant change in the amount of liquid flowing into the overflow box," "even if the liquid level position in the liquid tank changes vertically." (*Id.* at 0010-12.) One embodiment of Osada's new arrangement is illustrated below.



(Ex-1005-Osada at FIG. 4.) Osada explains it is "preferable to provide *multiple notches over a broad range*, and it is even more preferable to provide these notches *at uniform spacing* to ensure that it is possible *to force the flow of all of the floating impurities* that are easily suspended on the liquid surface and impurities that are more likely to be suspended in the lower layers *into the overflow box over **the entirety** of the liquid in the liquid tank*." (*Id.* at 0018.) Further, the notches may be of any shape, including "an inverted triangle shape" i.e., a V-shape, a U-shape, or a

rectangular shape, and any number of overflow boxes may also be used, including "one, two, or more." (*Id.* at 0017, 0019-21.) (Ex-1003-Dahm at ¶¶127-131.)

A POSITA would have been motivated and found it obvious to apply Osada's teachings to Best-2008. Both patents relate to open-air, liquid immersion tanks employing identical liquid recirculation loop concepts with the goals of ensuring proper liquid level height and liquid impurity and temperature control. Moreover, while Best-2008 discloses one manner of removing recirculating liquid from a tank (outlet pipe(s)) located in the wall(s) of the tank, it was obvious in view of Osada to use an overflow-weir system to remove recirculating liquid from an immersion tank for subsequent filtration and temperature control. Indeed, the conventional, rectangular weir of Osada was already "widely-used" with open-air liquid immersion tanks, and it was obvious to a POSITA to use Osada's conventional, rectangular weir with Best-2008's open-air liquid immersion tank as an alternative manner of removing recirculating liquid from its immersion tank, with subsequent conventional filtration and temperature control, as both Best-2008 and Osada teach. *KSR Int'l Co. v. Teleflex Inc.*, 127 S.Ct. 1727, 1742 (2007) ("When there is a design need…and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product not of innovation but of ordinary skill and common sense."). It was also obvious to use

Osada's weir-and-notch system with Best-2008 because it improves on and was a known alternative to the conventional rectangular weir design noted in Osada. (Ex-1003-Dahm at ¶134.) Either arrangement (conventional rectangular weir or weir-and-notches) would have resulted in expected success: an alternative and enhanced way to remove impurities from the Best-2008 system while still facilitating temperature control and liquid level height, as Best-2008 desires. (Ex-1003-Dahm at ¶¶132-134.)

Indeed, Best-2008 discloses several objectives, such as:

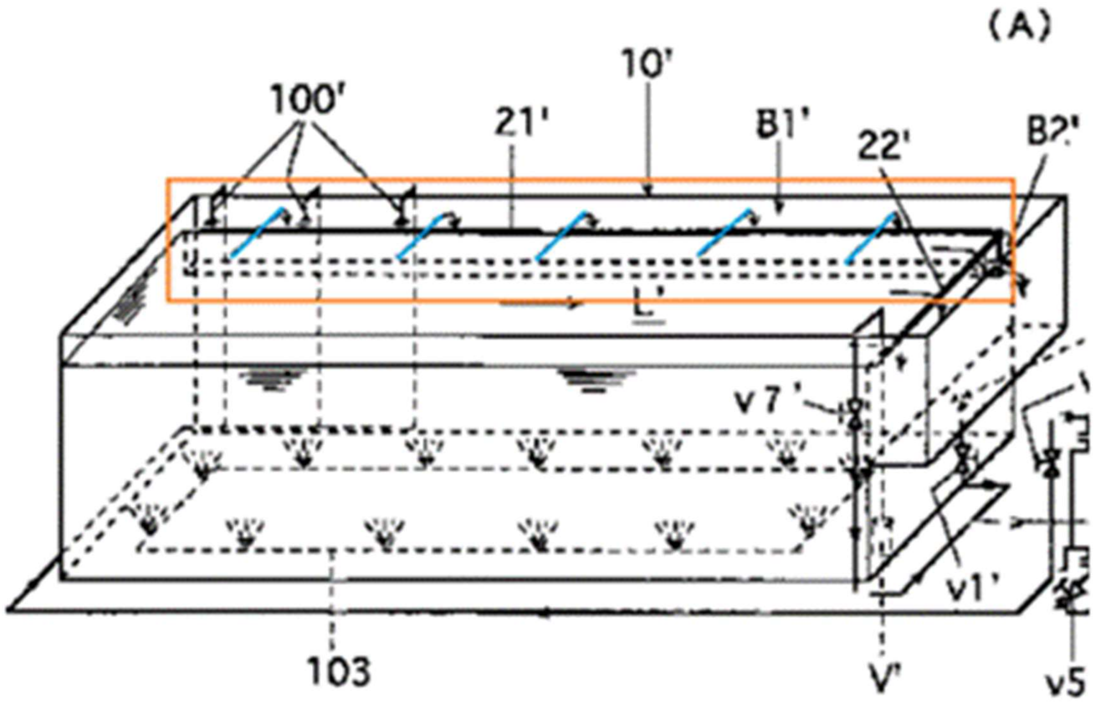
- flowing the dielectric coolant liquid between the plurality of servers, efficiently cooling each of the plurality of servers, and varying the liquid level in the tank to vary the depth to which the servers are immersed in the dielectric liquid (Ex-1004-Best-2008 at 0098, 0027-0030, 0066, 0080, 0098, 0102);
- adjusting the flow of the dielectric liquid coolant through the fluid circuit (*Id.* at 0026, 0073, 0082, 0098, 0102-0103, 0107, 0116, FIG. 17A-B);
- monitoring the temperature of the liquid at one or more locations in the liquid (*Id.* at 0027-28, 0068-69, 0073, 0082, 0126-127, FIG. 16, FIG. 17A);

- maintaining an elevated temperature in the liquid (*Id.* at 0027-28, 0074, 0111, FIG. 16, FIG. 17B);
- achieving a relatively uniform temperature in the coolant liquid (*Id.* at 0104, 0107);
- transferring heat from the liquid via a heat exchanger (*Id.* at 0030-31, 0070, 0081, 0105, 0126, FIG. 16, FIG. 17A);
- making use of vertical natural convection of the liquid coolant flow between servers (*Id.* at 0087, 0104);
- reducing coolant flow that bypasses the servers (*Id.* at 0088); and
- using fluid velocity augmentation devices to enhance the flow of liquid coolant through the servers (*Id.* at 0107, 0117, 0131, FIG. 17B).

These objectives are furthered by Osada's teachings. (Ex-1003-Dahm at ¶¶119, 140-149.)

Indeed, a POSITA would have recognized that Osada's teachings help remove impurities, prevent backflow, and facilitate temperature uniformity. (Ex-1003-Dahm at ¶¶126-128, 136.) While the Best-2008 system shows and describes multiple outlet pipes, a POSITA reading Best-2008 and Osada would have recognized that Osada's weir teachings facilitate temperature uniformity by creating substantially uniform flow through and out of the liquid tank, as Osada expressly illustrates:

(FIGURE 16)



(Ex-1005-Osada at FIG. 16(A).) As illustrated, Osada's ***fluid flow arrows*** (circled in orange) show the liquid overflowing over the weir (21') out of the long side of the tank in a uniform manner, which a POSITA would have recognized as being beneficial to temperature uniformity in the tank in comparison to a single outlet pipe located in the long or short wall of the tank. (Ex-1003-Dahm at ¶138.) A POSITA would have recognized that such an arrangement would have heat transfer benefits as the liquid would uniformly flow out of the tank at multiple locations, avoiding stagnant liquid. (Ex-1003-Dahm at ¶¶137-139.)

Osada's weir-and-notch arrangement also furthers temperature uniformity as it induces an upward flow of liquid, which serves as a means for enhanced upward flow of coolant through and out of Best-2008's tank. (Ex-1003-Dahm at ¶145.) A POSITA would have understood that the resulting induced upward flow of liquid coolant within the tank will increase the rate of heat transfer from the servers into the liquid, since the rate of convective heat transfer from the servers into the liquid coolant is known to increase as the liquid flow speed relative to the servers increases. (*Id.* at ¶¶146-147.) The induced flow also increases mixing of the dielectric liquid, leading to increased homogenization of the liquid temperature. (*Id.* at ¶¶148-149.)

For at least the above reasons, a POSITA would have been motivated to employ Osada's weir teachings with Best-2008. Doing so would facilitate not only improved filtration and liquid level maintenance, as expressly recognized by Osada, but also improved temperature uniformity within the tank. (Ex-1003-Dahm at ¶¶120-149.)

A POSITA also would have had a reasonable expectation of success in implementing the teachings of Osada with Best-2008. Best-2008 already includes an outlet pipe for recirculating its dielectric liquid and it would be simple to use Osada's conventional rectangular weir or new weir-and-notches teachings with Best-2008's tank in lieu of the outlet pipe, with the benefits previously noted. To do so, all that would be required is a simple mechanical reconfiguration of the tank to

use Osada's weir(s), which would be straightforward for a POSITA to implement. (Ex-1003-Dahm at ¶135.)

It was also simple to adopt Osada's overflow boxes to capture/catch the liquid overflow from such weirs for subsequent filtration and temperature maintenance (via an external heat exchanger) as taught by both Osada and Best-2008. Indeed, Osada teaches to place the boxes at the "upper peripheral side of the wall surrounding the liquid tank" (Ex-1005-Osada at 0018), and a POSITA would have recognized that doing so has many benefits, including minimizing splash (leading to loss of recoverable liquid) and oxygenation (leading to microbial fouling). It was not an option to exclude Osada's overflow boxes when adopting Osada's weir(s) because, otherwise, the liquid would not be captured as it flowed over the weir and would simply be lost. (Ex-1003-Dahm at ¶¶150-152, citing Ex-1017 at 818; Ex-1019 at 11-12; Ex-1021 at 416, 422, 457.) It was also straightforward for a POSITA to implement Osada's overflow boxes—attaching an exterior box to a tank, such as taught by Osada, is well within the capabilities of a POSITA. (Ex-1003-Dahm at ¶153.)

B. Challenged Claims

Ground 1 challenges all claims 1-16. Petitioner first addresses claims 1-5 (the first claim set), with the second and third claim sets (claims 6-10 and 11-16) addressed thereafter.

1. Claim Set 1

[1.0] "An appliance immersion cooling system comprising:"

Best-2008 teaches the preamble. Specifically, Best-2008 discloses "novel apparatus, systems, and methods for efficiently cooling computing devices having heat-generating electronic components, such as, for example, independently operable servers immersed in a dielectric liquid coolant in a tank." (Ex-1004-Best-2008 at 0025; Ex-1003-Dahm at 158-160.)[11]

Thus, Best-2008 teaches the preamble.

[1.1] "a tank adapted to immerse in a dielectric fluid a plurality of electrical appliances, each in a respective appliance slot distributed vertically along, and extending transverse to, a long wall of the tank, the tank comprising:"

Best-2008 teaches this limitation. Specifically, Best-2008 discloses a variety of tank arrangements, each of which is "adapted to immerse in a dielectric fluid a plurality of electrical appliances." (Ex-1004-Best-2008 at FIGS. 3-15, 0060-0120). As one example, FIG. 3 illustrates a tank (410) "for immersing a rack of independently operable servers in a liquid coolant." (*Id.* at 0083.) The liquid coolant may be a dielectric fluid. (*Id.* ("The tank 410 may be fabricated of [material] that is compatible *with the dielectric liquid coolant* used as a cooling medium."))

[11] The '457 patent admits Best-2008 teaches this limitation. (Ex-1001 at 2:23-27.)

The tank is configured to form a server rack (470) where the servers are generally vertically oriented with the front facing upwards:

> "Suitable mounting members may be used to mount the servers in the tank to form the server rack 470 within the tank." (*Id.*)
>
> "[T]he mounting members are configured to mountably receive the plurality of servers ***in a vertical orientation***, thereby minimizing the footprint of the servers relative to the ground, and with the 'front' panel facing upward for easy installation and removal of a server without the need to remove or disturb any other server within the tank 410." (*Id.* at 0085.)

"Ears" of the servers may be used to hold the servers in the rack:

> "Suitable mounting members may be used to mount the servers in the tank to configure the server rack 830 and 832 within the tank. Specifically, the mounting members (not shown) may be fixedly attached along the length L of each longer side of the tank 810 and in the middle of the tank 810 between the two shorter ends of the tank to support ***the rack ears 836 of a standard rack-mountable server 820 shown in FIG. 12A***." (*Id.* at 0097.)

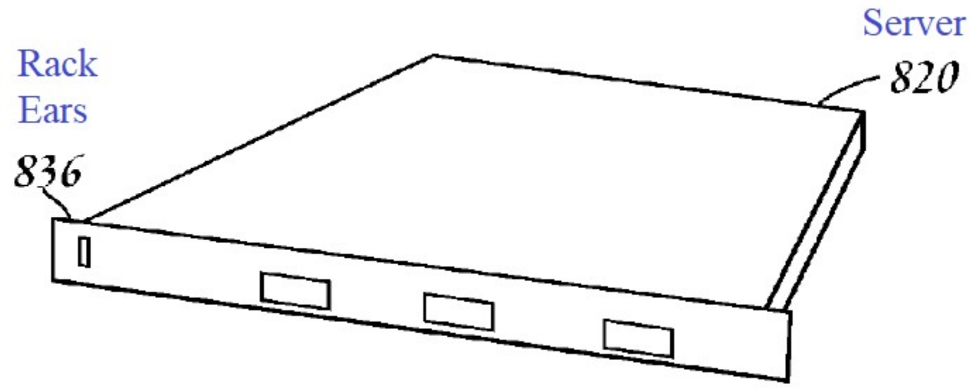


Fig. 12A

As shown in FIGS. 4 and 6, for instance, "a respective appliance slot [is] distributed vertically along the long wall of the tank:"

> "The tank 410 may face upward with an open top 430 to form an open interior volume and may be shaped to have a length L, width W, and height H with the minimum footprint to insert multiple servers 120." (*Id.* at 0083.)

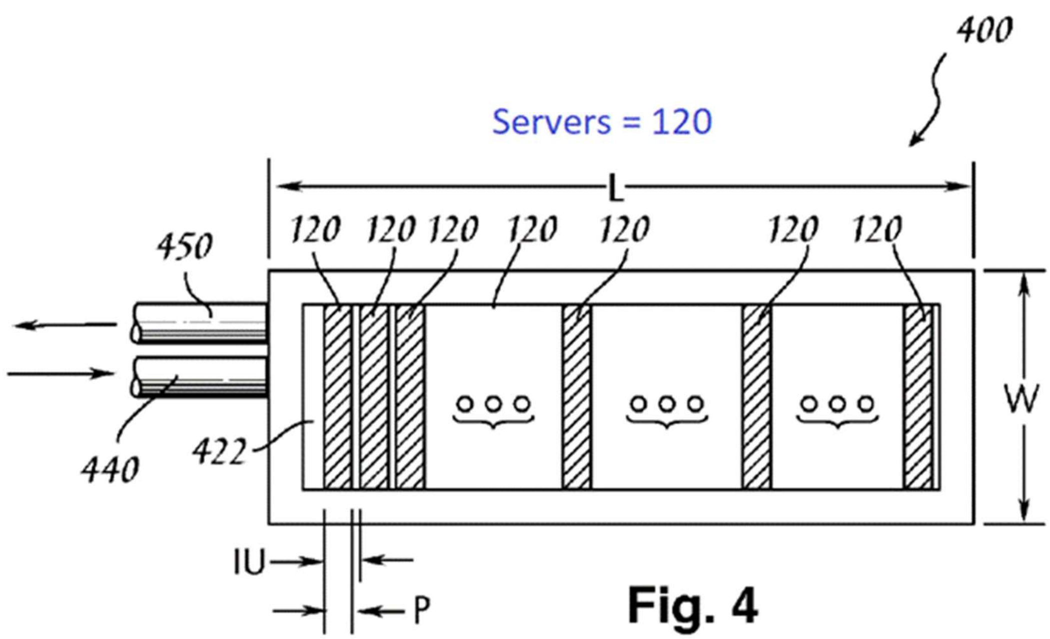


Fig. 4

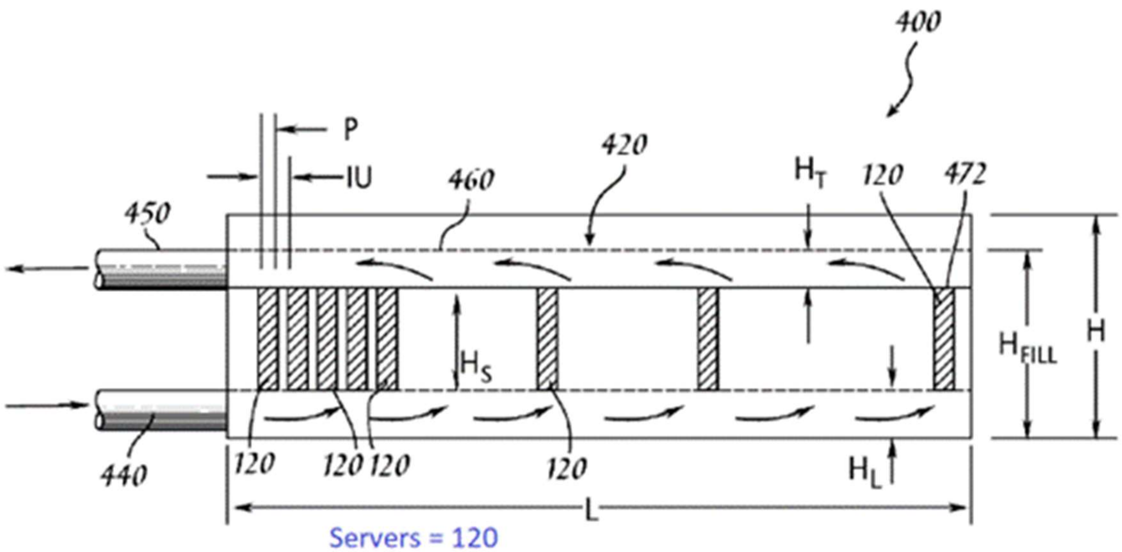


Fig. 6

(*See id.* at FIG. 11 and 0097-0107 (showing and describing plurality of servers in vertical orientation in slots of a tank and immersed in dielectric fluid).) For at least these reasons, Best-2008 discloses this limitation. Indeed, the '457 patent confirms that Best-2008 discloses the slot requirement of the claims. (Ex-1001 at 2:31-33 ("through the several appliance slots within the tank").) (Ex-1003-Dahm at ¶¶161-166.)

Additionally, Best-2008 discloses that the tank may include a dedicated bin for each appliance:

> "In another alternative rack design (not shown in the drawings), <u>*the tank 410 is divided into a plurality of bins with each bin being sized to receive one corresponding server with the 'front panel' facing upward*</u>." (Ex-1004-Best-2008 at 0090.)

Because each bin is "sized to receive one corresponding server with the 'front panel' facing upward," Best-2008's bins also disclose or suggest the use of slots for holding each server that is immersed and cooled in dielectric liquid. (Ex-1003-Dahm at ¶¶167-170.)

Thus, Best-2008 teaches this limitation.

[1.2] "a weir, integrated horizontally into the long wall of the tank adjacent all appliance slots, having an overflow lip adapted to facilitate substantially uniform recovery of the dielectric fluid flowing through each appliance slot; and"

Best-2008 in view of Osada teaches this limitation.

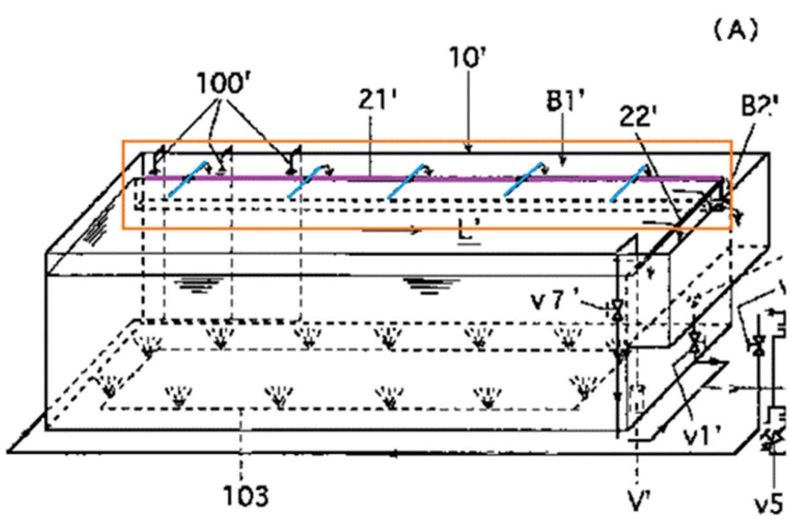
Specifically, Best-2008 discloses outlet pipe(s) integrated into the short and/or long walls of its tank. (Ex-1004-Best-2008 at FIGS. 3-4 and 6 (showing an outlet pipe (450) is located in a wall of the tank), 0084, 0087.) While the illustrations of FIGS. 3-6 show the outlet pipe (450) in the short wall of the tank, Best-2008 discloses that the outlet pipe may also be located in the long wall of the tank. (*Id.* at 0092 (explaining both inlet and outlet pipes "may be located nearer one end of one of the longer sides of the rectangular tank").) Thus, Best-2008 discloses a weir integrated into the long wall of its tank. (Ex-1003-Dahm at ¶¶171-174.)

As explained in §VIII.C, in the Prior IPR, Patent Owner contended that this limitation requires the weir to be integrated into the wall adjacent *all* appliance slots. Best-2008 does not expressly disclose such an arrangement, but such arrangements were known and conventional as shown by Osada. (Ex-1003-Dahm at ¶175.)

Specifically, as explained in §X.A, Best-2008 discloses a variety of liquid recirculation loops (circuits), but does not expressly disclose a recirculation loop that uses an weir-overflow-reservoir arrangement. Osada does, and a POSITA would have been motivated and found it obvious to use the conventional weir or the weir-and-notches teachings of Osada with Best-2008 to achieve improved filtration, temperature uniformity, and/or liquid level maintenance with a reasonable expectation of success. (*See* §X.A; Ex-1003-Dahm at ¶176.)

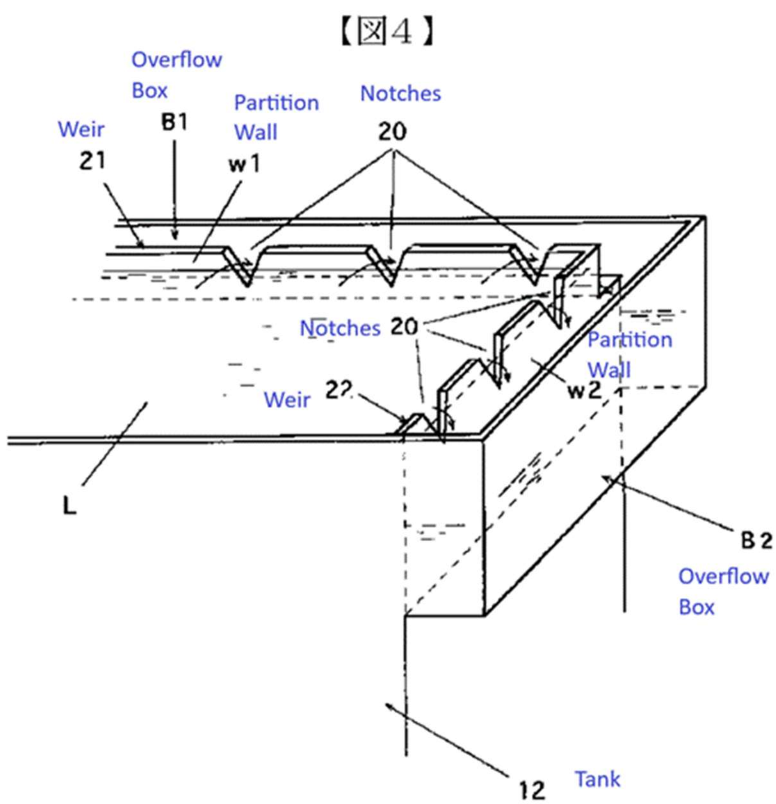
A POSITA would have been motivated to locate Osada's conventional weir or weir-and-notches along *the entire length* of the long wall of Best-2008's tank. Indeed, as illustrated, the conventional ***weir*** (21') extends the entire length of the long wall of the tank resulting in ***uniform liquid flow*** out of the tank and into overflow box B1':

(FIGURE 16)



(Ex-1005-Osada at FIG. 16(A).) Accordingly, the combination of Best-2008 and Osada's conventional weir teaches "a weir, integrated horizontally into the long wall of the tank adjacent all appliance slots, having an overflow lip adapted to facilitate substantially uniform recovery of the dielectric fluid flowing through each appliance slot." (Ex-1003-Dahm at ¶¶177-178.)

Best-2008 in view of Osada's weir-and-notches arrangement also teaches this limitation. Specifically, a POSITA would have recognized that Osada's notches would extend the full length of the tank. One example of this arrangement is illustrated in FIG. 4:



(Ex-1005-Osada at FIG. 4.)

As shown, even though FIG. 4 is a partial view, the notches are already spaced regularly and uniformly in the long wall of the tank.[12] Moreover, Osada teaches that there should be "multiple notches over a broad range," and "at uniform spacing to ensure that it is possible to force the flow of all of the floating impurities that are easily suspended on the liquid surface and impurities that are more likely to be suspended in the lower layers into the overflow box over the entirety of the liquid in the liquid tank." (*Id.* at 0018.) Thus, a POSITA would have been motivated and found it obvious to include multiple, uniformly spaced notches across the tank of Best-2008 when implementing Osada's weir-and-notches. (Ex-1003-Dahm at ¶¶179-181.)

Finally, Best-2008 teaches that its "liquid coolant may *__flow through **each** installed server__*," and "the liquid coolant heated by the heat generating components in the servers" should "naturally rise through the servers and exit through the front

[12] Osada's conventional weir and weir-and-notches arrangements are also illustrated as being located in the short wall of the tank. The claims of the '457 patent do not preclude such an arrangement, and, in any event, Osada also teaches that a single overflow box may be used, i.e., it was obvious to only include a conventional weir or weir-and-notches in the long wall of the Best-2008 immersion tank. (Ex-1003-Dahm at ¶¶132, 181, FN.2.)

panel of the servers" to achieve a "relatively uniform temperature." (Ex-1004-Best-2008 at 0104.) Best-2008 further teaches:

> "The mounting members may also be configured to mount the servers in the server rack 470 above the bottom of the tank *to create a volume of liquid coolant* ***between*** *each respective server and the bottom of the tank* ***such that the flow of the dielectric liquid coolant through the servers is improved***. Preferably, the mounting members are configured to mount the servers closely adjacent to one another in the server rack to restrict the flow of the dielectric liquid coolant between the vertically-oriented servers, *such that the flow of the dielectric liquid coolant through the servers is enhanced*." (Ex-1004-Best-2008 at 0086.)

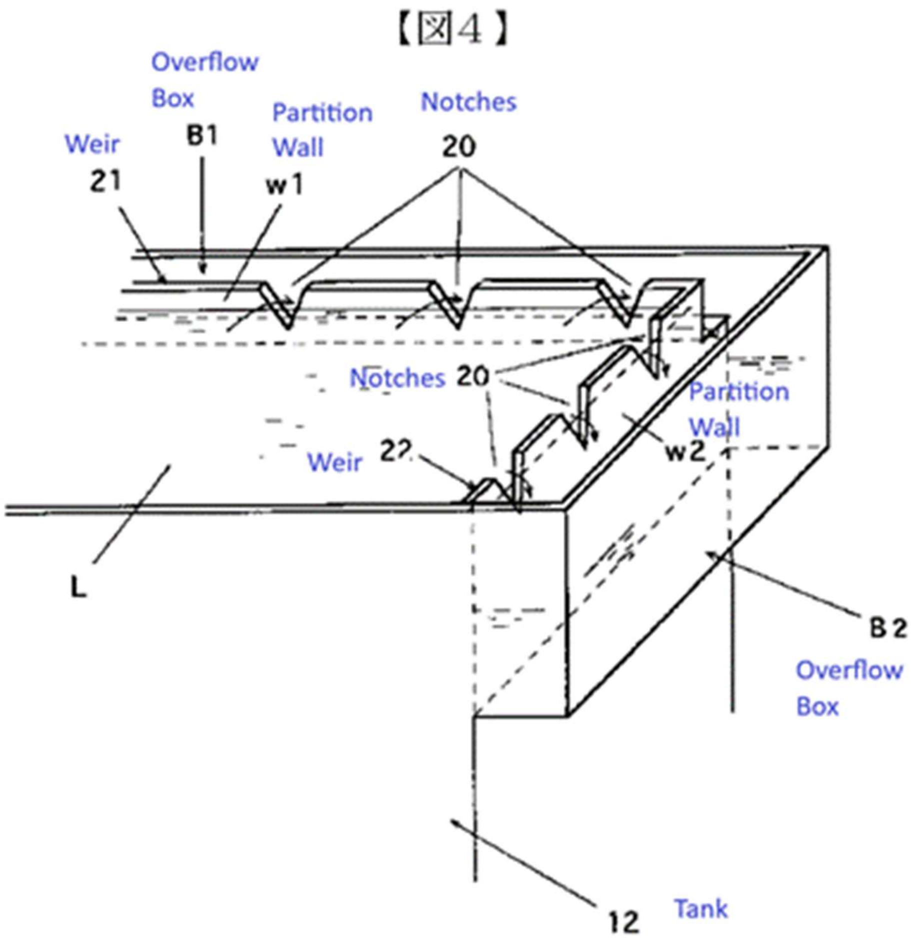
Accordingly, a POSITA would have been motivated to include Osada's notches adjacent each appliance slot in the Best-2008 tank. Doing so facilitates achievement of Best-2008's objectives of achieving coolant flow through and between "each installed server," "such that the flow of the dielectric liquid coolant through the servers is improved" while also achieving a "relatively uniform" liquid coolant temperature" in Best-2008's tank. (Ex-1003-Dahm at ¶¶182-185.)

Thus, Best-2008 in view of Osada teaches limitation 1.2.

[1.3] "a dielectric fluid recovery reservoir positioned vertically beneath the overflow lip of the weir and adapted to receive the dielectric fluid as it flows over the weir; and"

Best-2008 in view of Osada teaches this limitation.

As explained in §X.A and in limitation 1.2, a POSITA would have been motivated and found it obvious to use Osada's conventional weir and weir-and-notches teachings with Best-2008 with a reasonable expectation of success. In such an arrangement, a POSITA would have used Osada's "overflow boxes" to capture the liquid overflow—otherwise, the fluid would be wasted/lost. (Ex-1003-Dahm at ¶¶150-153.) One such arrangement is illustrated below:



(Ex-1005-Osada at FIG. 4.)

As explained previously, Osada teaches placing overflow boxes "on the upper peripheral side of the wall surrounding the liquid tank" which a POSITA would

recognize as being beneficial to minimize splashing and oxygenation of the liquid. (Ex-1005-Osada at 0018; Ex-1003-Dahm at ¶¶186-188.) Doing so results in a Osada's overflow boxes being "positioned vertically beneath the overflow lip of the weir and adapted to receive the dielectric fluid as it flows over the weir." (Ex-1003-Dahm at ¶¶189-190.)

Thus, Best-2008 in view of Osada teaches this limitation.

[1.4] "a primary circulation facility adapted to circulate the dielectric fluid through the tank, comprising: a plenum, positioned adjacent the bottom of the tank, adapted to dispense the dielectric fluid substantially uniformly upwardly through each appliance slot;"

A "primary circulation facility" according to the '457 patent at least includes the pumps, valves and/or piping required to move the dielectric fluid through the tank. (Ex-1001 at 4:50-61; Ex-1003-Dahm at ¶192.)

Best-2008 teaches this limitation. FIGS. 1A, 1B, and 2 of Best-2008 show various pumps, heat exchangers, and piping arrangements that may be used to recirculate the dielectric fluid through the tank of Best-2008 via a first liquid circuit. As Best-2008 explains:

> "The liquid coolant heated by the servers 120 in the server rack is then fluidly coupled through suitable piping or lines to a pump 130, which pumps the heated liquid coolant through suitable piping or lines to a remotely or distally located heat exchanger 140 associated with a heat-rejection or cooling apparatus 150. The distally heat exchanger 140 rejects the heat from the incoming heated liquid

> coolant and fluidly couples the cooled liquid coolant through a return fluid line or piping 170 back into the tank 110. *Thus, at least a portion of the liquid coolant completes a fluid circuit through the servers 120 in the tank 110, pump 130, heat exchanger 140, and back into the tank 110*." (Ex-1004-Best-2008 at 0067.)

Accordingly, Best-2008 teaches a primary circulation facility. (Ex-1003-Dahm at ¶¶191, 193-194.)

Best-2008 further discloses the claimed plenum. As explained previously, a "plenum" according to Patent Owner is simply "a structure for dispensing liquid." (*See* §VIII.B.) Best-2008 discloses such structures. For instance, FIG. 6 of Best-2008 shows that the inlet pipe (440) dispenses the cooled dielectric fluid through a plenum adjacent the bottom of the tank.

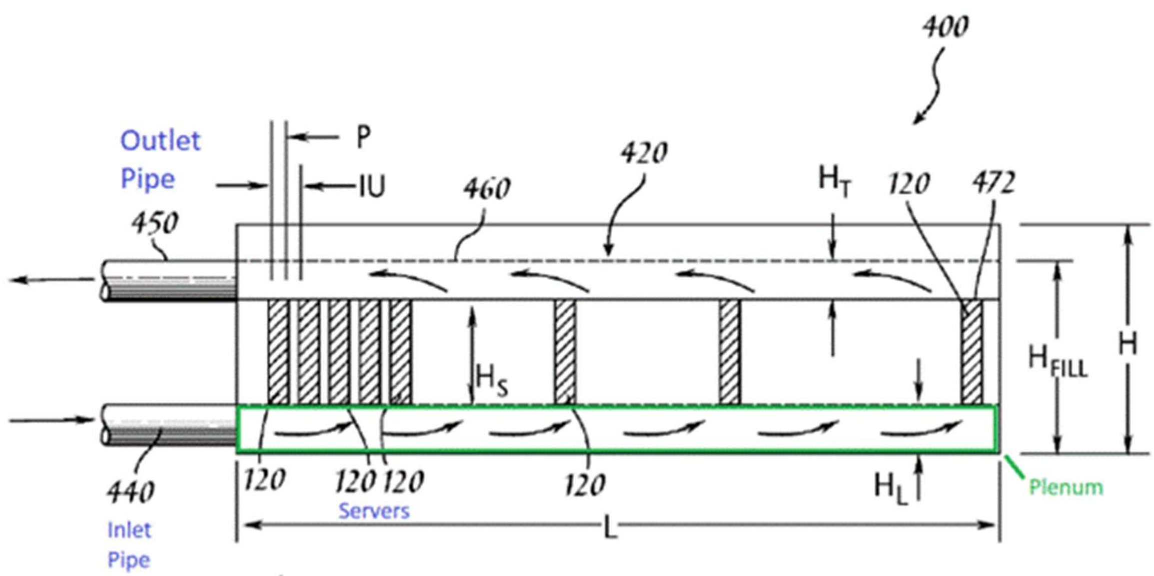


Fig. 6

(Ex-1004-Best-2008 at FIG. 6.) As the arrows indicate, the fluid is dispensed "substantially uniformly upwardly through each appliance slot." For this reason alone, Best-2008 discloses the claimed "plenum." (Ex-1003-Dahm at ¶¶195-197.)

Best-2008 further discloses that its mounting members should be configured "to create a volume of liquid coolant between each respective server and ***the bottom of the tank*** such that the flow of the dielectric liquid coolant through the servers is improved," and such that the servers are closely spaced to "to restrict the flow of the dielectric liquid coolant between the…servers, such that the flow of the dielectric liquid coolant through the servers is enhanced." (Ex-1004-Best-2008 at 0086.) Best-2008 further discloses the use of mechanical structures below the servers to uniformly distribute the liquid:

> "Additional fluid velocity augmentation devices, such as multiple fans 880 *may be mounted under each of the server racks 830 and 832* in the volume of liquid coolant between the plurality of servers in each respective rack and the bottom of the tank to increase the mixing of the dielectric liquid coolant within the tank, and improving the flow of the coolant through the plurality of servers." (*Id.* at 0107.)
>
> "The various components of the system 900 controlled by the controller 920 include *any fluid velocity augmentation devices positioned below the server racks*…." (*Id.* at 0123.)

Fluid velocity augmentation devices include fans and nozzles (orifices). (*Id.* at 0107, 0123; Ex-1003-Dahm at ¶¶269, 278.) For these additional reasons, Best-2008 discloses the claimed plenum. (Ex-1003-Dahm at ¶¶198-200.)

Thus, Best-2008 teaches this limitation.

[1.5] "a secondary fluid circulation facility adapted to extract heat from the dielectric fluid circulating in the primary circulation facility, and to dissipate to the environment the heat so extracted; and"

Best-2008 teaches this limitation. FIGS. 1A, 1B and 2 of Best-2008 illustrate a secondary fluid circulation facility that may be used "to extract heat from the dielectric fluid circulating in the primary circulation facility, and to dissipate to the environment the heat so extracted." One example is shown in FIG. 1A, below, where a cooling apparatus (150) employs a cooling liquid in a second fluid circuit in communication with a heat exchanger (140).

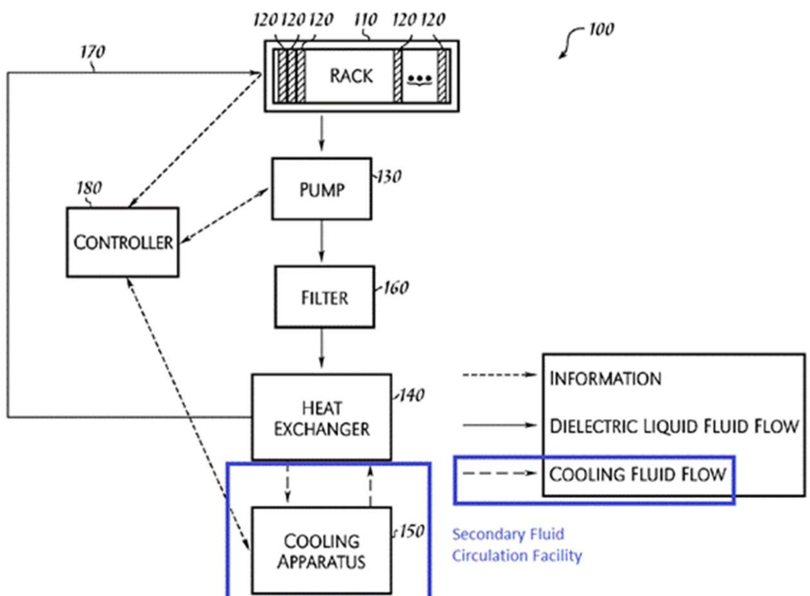


Fig. 1A

(Ex-1004-Best-2008 at FIG. 1A.)

As Best-2008 explains:

> "The heat rejected from the heated liquid coolant through the heat exchanger 140 may then be selectively used by alternative heat rejection or cooling apparatus 150…to dissipate, recover, or beneficially use the rejected heat depending on the different environmental conditions and/or server operating conditions to which the system is subject." (*Id.* at 0067.)

Thus, Best-2008 teaches this limitation. (Ex-1003-Dahm at ¶¶201-205.)

<u>[1.6] "a control facility adapted to coordinate the operation of the primary and secondary fluid circulation facilities as a function of the temperature of the dielectric fluid in the tank."</u>

Best-2008 teaches this limitation. FIGS. 1A, 1B, and 2 of Best-2008 disclose a control facility "to coordinate the operation of the primary and secondary fluid circulation facilities as a function of the temperature of the dielectric fluid in the tank." One example is shown in FIG. 1A, below, where a controller (180) coordinates the operation of the pump (130) and cooling apparatus (150):

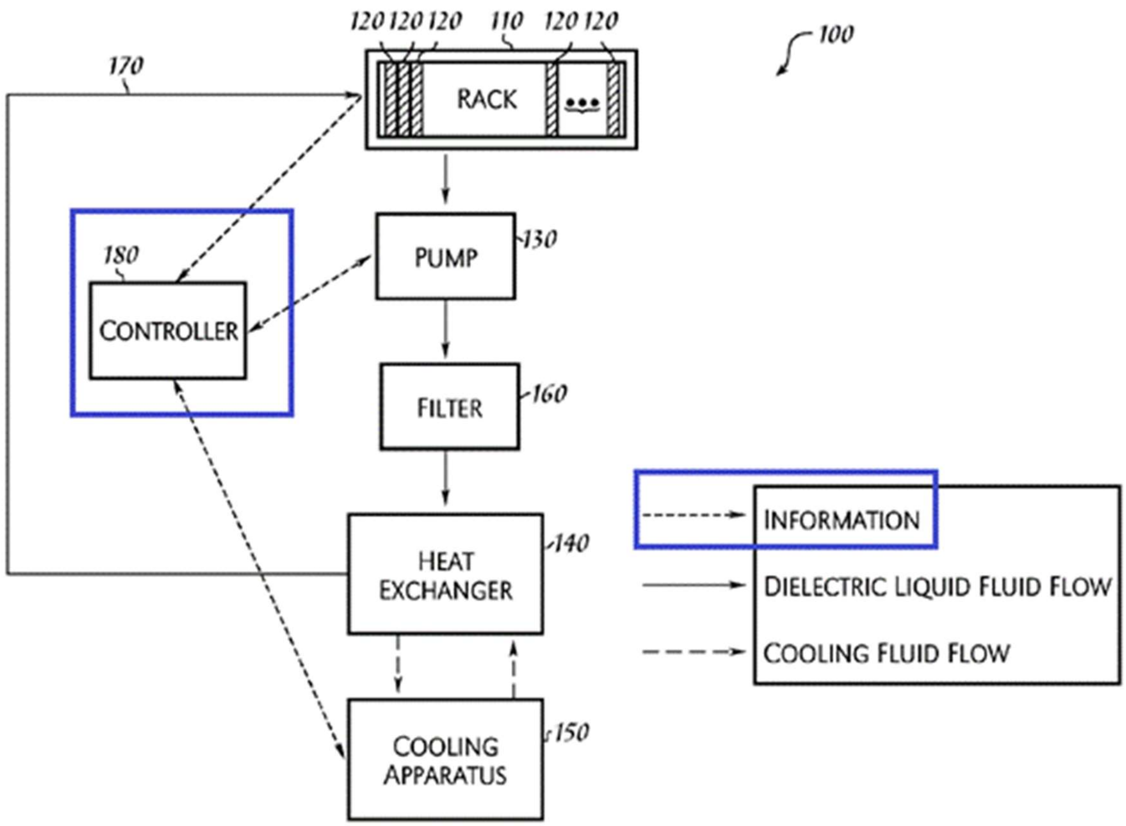


Fig. 1A

(Ex-1004-Best-2008 at FIG. 1A.) Specifically, Best-2008's controller (180) may receive "monitor signals of various operational parameters from various components of the cooling system 100 and the environment and may generate control signals to control various components of the cooling system to maintain the heated liquid coolant exiting the servers in the tank at a specific elevated temperature." (*Id.* at 0068.) Best-2008's controller uses that information to "output signals to the pump 130 and heat rejection or cooling apparatus 150 to adjust the flow of the liquid coolant through the fluid circuit and the amount of the heat being rejected by the heat rejection or cooling apparatus 150 for sufficiently cooling each respective

server while maintaining the heated liquid coolant exiting the servers at the elevated temperature to reduce the amount of energy consumed to sufficiently cool each of the servers in the server rack." (*Id.*; *see id.* at FIG. 17B, 0135; FIG. 15, 0120-0125; Ex-1003-Dahm at ¶¶206-211.)

Thus, Best-2008 teaches this limitation, and Best-2008 in view of Osada renders obvious claim 1.

[Claim 2] "The system of claim 1 wherein the tank and primary circulation facility comprise a highly-integrated module.

To the extent this limitation can be understood, it is rendered obvious by Best-2008. For instance, Best-2008 discloses that its heat exchanger (280) (primary circulation facility) may be located inside the tank, as shown by, for instance FIG. 1B:

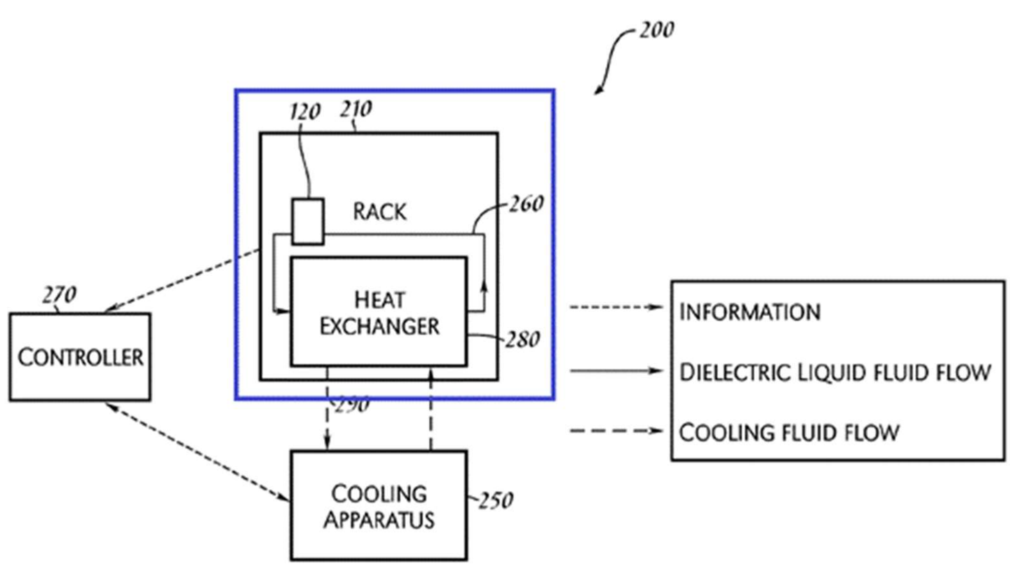


Fig. 1B

(Ex-1004-Best-2008 at FIG. 1B; 0069-70.) The above arrangement constitutes a "highly-integrated module" to the same extent such a module is disclosed by the '457 patent. (Ex-1003-Dahm at ¶¶212-215.)

Osada also discloses to employ filtration (e.g., "suction heads") in its overflow boxes to address "inorganic and organic impurities in the processing liquid that flow into said box over the weir part that range in size from large to small particle diameters, and further, the bits of the article being processed that have dropped into said box from the outside [that] may clog the outflow port at the bottom of said box." (Ex-1005 at 0026-27; *id.* at 0031, 0047-49, FIGS. 6(C), 7-8.) The use of such filtration in the overflow boxes also reads on a "highly integrated module," and it would have been obvious to use such filtration in the overflow boxes when implementing Osada's weir teachings with Best-2008. (Ex-1003-Dahm at ¶¶216-217.)

Thus, both Best-2008 and Osada teach this limitation and Best-2008 in view of Osada renders obvious claim 2.

[Claim 3] "The system of claim 1 wherein the tank further comprises: an interconnect panel facility adapted to mount appliance support equipment."

An "interconnect panel facility" according to the '457 patent at least includes a location where power distribution equipment, cable connection panels, and the like may be mounted. (Ex-1001 at 3:56-60 ("an interconnect panel facility 24 attached

to the upper rear edge of the tank 14 and *adapted to mount various appliance power distribution equipment, cable interconnection panels and the like* (none shown);”); Ex-1003-Dahm at ¶219.)

Best-2008 teaches this limitation. For instance, the Best-2008 tank may include “cable trays 840 mounted along two sides of the tank 810 paralleling the sides of the server racks 830 and 832 to organize the signal and control network cabling 842 from the servers to the controller and other computers in the data center and beyond,” and “power distribution units (‘PDUs’) 844 mounted above the space between the server racks in order to distribute needed electrical power through suitable power cables 846 to the multiple servers.” (Ex-1004-Best-2008 at 0100; FIG. 13; Ex-1003-Dahm at ¶¶218, 220-221.)

Thus, Best-2008 teaches this limitation, and Best-2008 in view of Osada renders obvious claim 3.

[Claim 4] “The system of claim 1 wherein the primary circulation facility further comprises: at least first and second primary circulation sub-facilities, each adapted to operate independently to circulate the dielectric fluid through the tank; wherein the control facility is further adapted to coordinate the operation of the first and second primary circulation sub-facilities and the secondary fluid circulation facilities so to maintain the temperature of the dielectric fluid in the tank substantially between a predetermined minimum temperature and a predetermined maximum temperature.”

Best-2008 teaches this limitation. Specifically, Best-2008 provides that its teachings regarding FIGS. 1A and 1B may be combined, wherein a first sub-facility

(e.g., remote heat-exchanger) is used to cool the dielectric liquid, and a second sub-facility (heat-exchanger within the tank) may be independently used as an alternative:

> "FIG. 9 depicts an end elevation view of yet another illustrative embodiment of a suitable fixture or server rack apparatus 600 for use in connection ***with a combination of system 100 of FIG. 1A and system 200 of FIG. 1B***. *In such a combination, there are two alternative modes of operating the cooling system for cooling the dielectric liquid coolant wherein the controller may switch the mode of operation depending on the environmental conditions*. … *In* ***the first mode*** *of operation* utilizing a mode of operation comparable to that of FIG. 1A, the fluid flow 660 of the liquid coolant entering the tank through the inlet piping 640 is initially through the space 662 formed by the bottom of the side of the tank containing the inlet piping 640 and the bottom 672 of the server rack 670 of servers 120 and then through the bottom 672 of the server rack through the servers 120 and out the front panel side 674 of the server rack into a space 676 formed by the top 674 of the server rack and the top surface 622 of the liquid coolant and nearer the outlet piping 650. *To permit* ***the second mode*** *of operation similar to FIG. 1B, a second heat exchanger 680 associated with an additional secondary cooling apparatus is mounted within the tank 610* and a second inlet piping 682 and a second output piping 684 are inserted through the wall of the tank 610 and fluidly coupled to the heat exchanger to permit the flow of a separate second cooling fluid through the input piping 682,

second heat exchanger 680, and outlet piping 684 back to the second secondary cooling apparatus." (Ex-1004-Best-2008 at 0092.)

"*In the second mode of operation, the pump associated with the first mode of operation is deactivated by the controller such that the fluid circuit flow of the dielectric liquid coolant to the external heat exchanger of the first secondary cooling apparatus is deactivated. Next the internal heat exchanger 680 associated with the second alternative secondary cooling apparatus is activated by the controller*. In this mode the fluid flow of the dielectric fluid within the tank is reconfigured such that the heated dielectric liquid coolant fluid flow 660 flowing out of the servers 120 does not flow out of the outlet piping 650. Instead, at least a portion of the liquid coolant fluid flow 660 is through the heat exchanger 680 to the bottom of the tank 610 and then back through the servers 120. The heat rejected from the heat exchanger 680 is thermally coupled to the second cooling fluid of the second secondary cooling system for dissipation or recovery." (*Id.* at 0093.)

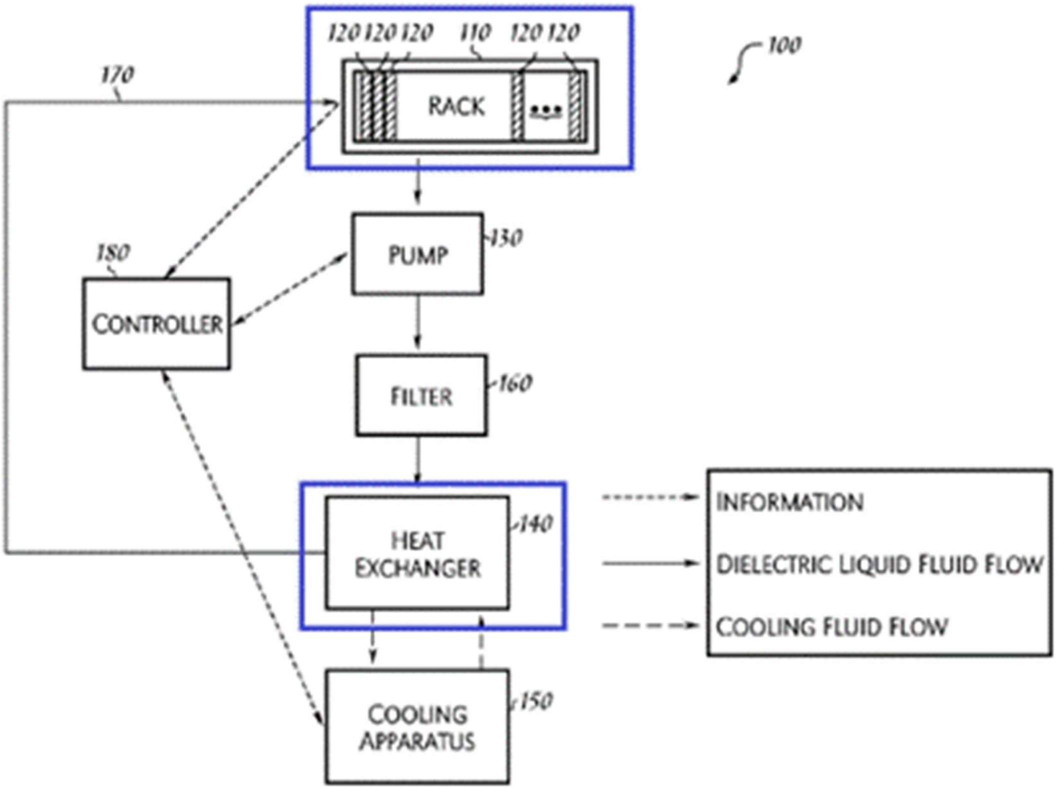

100
120 120 120
110
120 120
170
RACK
PUMP
130
180
CONTROLLER
FILTER
160
HEAT EXCHANGER
140
INFORMATION
DIELECTRIC LIQUID FLUID FLOW
COOLING FLUID FLOW
COOLING APPARATUS
150

Fig. 1A

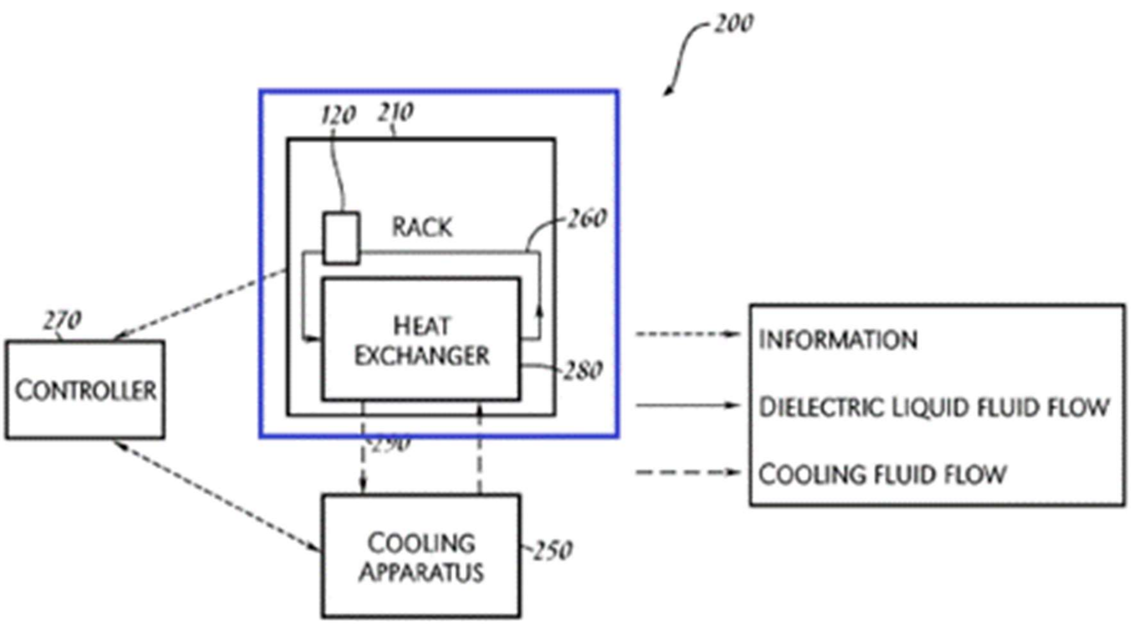

200
120
210
RACK
260
HEAT EXCHANGER
280
270
CONTROLLER
290
INFORMATION
DIELECTRIC LIQUID FLUID FLOW
COOLING FLUID FLOW
COOLING APPARATUS
250

Fig. 1B

(Ex-1004-Best-2008 at FIGS. 1A-1B.) FIG. 10 of Best-2008 also describes the use of two different primary cooling sub-facilities that read on the claim. (Ex-1004-Best-2008 at FIG. 10; 0094-96.) Thus, Best-2008 teaches "wherein the primary circulation facility further comprises: at least first and second primary circulation sub-facilities, each adapted to operate independently to circulate the dielectric fluid through the tank; wherein the control facility is further adapted to coordinate the operation of the first and second primary circulation sub-facilities and the secondary fluid circulation facilities." (Ex-1003-Dahm at ¶¶222-225.)

Best-2008 further teaches that its system is used to maintain the servers within a predetermined temperature range. (Ex-1004-Best-2008 at 0136-38 (explaining use of controller to maintain liquid coolant temperature at, for instance, "between 90 and 130 degrees F.").) A POSITA would have understood these teachings to apply to the dual-mode operation explained above as the purpose is to maintain the servers within the predetermined operating range. (Ex-1003-Dahm at ¶¶226-228.) Indeed, as Best-2008 explains:

> "A combination of the system 100 and 200 using the alternative server rack apparatus of FIG. 9 and FIG. 10 *<u>that permit two different modes of operating the server rack cooling system for cooling the dielectric liquid coolant may be useful in certain applications and climates, for example, in an arid climate having cool nights and very hot days</u>*. During the cool days, the combination system employing

> the embodiments of FIG. 9 or FIG. 10 may be used in a first mode similar to that of FIG. 1A wherein the dielectric fluid is fluidly coupled to an external heat exchanger associated with a radiator-type secondary cooling system. During the hot days, the combination system may be used in a second mode similar to that of FIG. 1B wherein the dielectric liquid coolant is fluidly coupled through the internal heat exchanger, which is associated with a second secondary cooling apparatus, such as a vapor-compression cycle refrigeration cooling system." (Ex-1004-Best-2008 at 0096.)

A POSITA would recognize that Best-2008 is using the two different modes of operation to efficiently maintain the servers within a predetermined temperature range. (Ex-1003-Dahm at ¶¶228-230.)

Thus, Best-2008 also teaches the remainder of this limitation (i.e., "so to maintain the temperature of the dielectric fluid in the tank substantially between a predetermined minimum temperature and a predetermined maximum temperature"), and Best-2008 in view of Osada renders obvious claim 4.

[Claim 5] "The system of claim 1 wherein the control facility further comprises a communication facility adapted to facilitate monitoring and control of the control facility from a remote location."

The '457 patent describes "remote location" functionality once in the specification and in the context of conventional electronic communications:

> "One desirable enhancement that we recommend *is a remote control facility*, implemented, e.g., via the master controller 62 (or by way of

> a direct, per-controller interface), *adapted to facilitate remote monitoring of system status (e.g., temperatures, pressures, etc.) and control over system control parameters* (e.g., temperature and pressure limits, etc.) to the primary controllers 58 and secondary controllers 60. For example, using *a conventional* data communication hardware module 64, e.g., an ethernet card implementing the TCP/IP protocol, *a modern* web browser can be adapted to provide a graphical user interface ("GUI") with sufficient functionality to facilitate monitoring and control of an entire installation from a remote location. Such a GUI may be implemented using any of a number of programming paradigms, e.g., PHP, .NET and the like." (Ex-1001 at 6:7-21; Ex-1003-Dahm at ¶232.)

Best-2008 teaches this limitation. For instance, FIGS. 1A, 1B and 2 show Best-2008's controller located remote of the tank. As Best-2008 describes:

> "The system 100 includes *a computer controller 180* of conventional design with suitable novel applications software for implementing the methods of the present invention. *The controller 180* may receive monitor signals of various operational parameters from various components of the cooling system 100 and the environment and may generate control signals to control various components of the cooling system to maintain the heated liquid coolant exiting the servers in the tank at a specific elevated temperature in order to sufficiently cool each of the servers while reducing the total amount of energy needed to cool the servers." (Ex-1004-Best-2008 at 0068.)

Best-2008 further notes that its components may be "remotely controlled." (*Id.* at 0081 ("The fluid valve 390 may be *remotely controlled* to connect the heated liquid coolant being pumped through the collection piping from the tank 310 *to a controller-selected one of* alternative *remotely or distally* located heat exchangers associated with alternative heat rejection or cooling apparatus 350.") Best-2008 further states "[t]he computer controller *doesn't necessarily have to [be] separate* from the servers that are being cooled," indicating the computer controller may be separate (remote) from the servers being cooled. (*Id.* at 0138; Ex-1003-Dahm at ¶¶231, 233-235.)

FIG. 15 of Best-2008 also illustrates a controller 920 and heat exchanger 910 located outside of a "server room" 901,[13] the controller being designed to control the liquid flow and temperature of the many server racks located in that server room:

[13] Best-2008 does not include a description of reference number "901" in its text, but it is apparent from the illustration that box 901 is intended to be the server room of FIG. 15, at least because that box 901 has a thicker line that surrounds the server racks 310, but not the heat exchanger, and the heat exchanger is described as being "distally located" of the server room. (Ex-1003-Dahm at ¶238; Ex-1004-Best-2008 at 0030.)

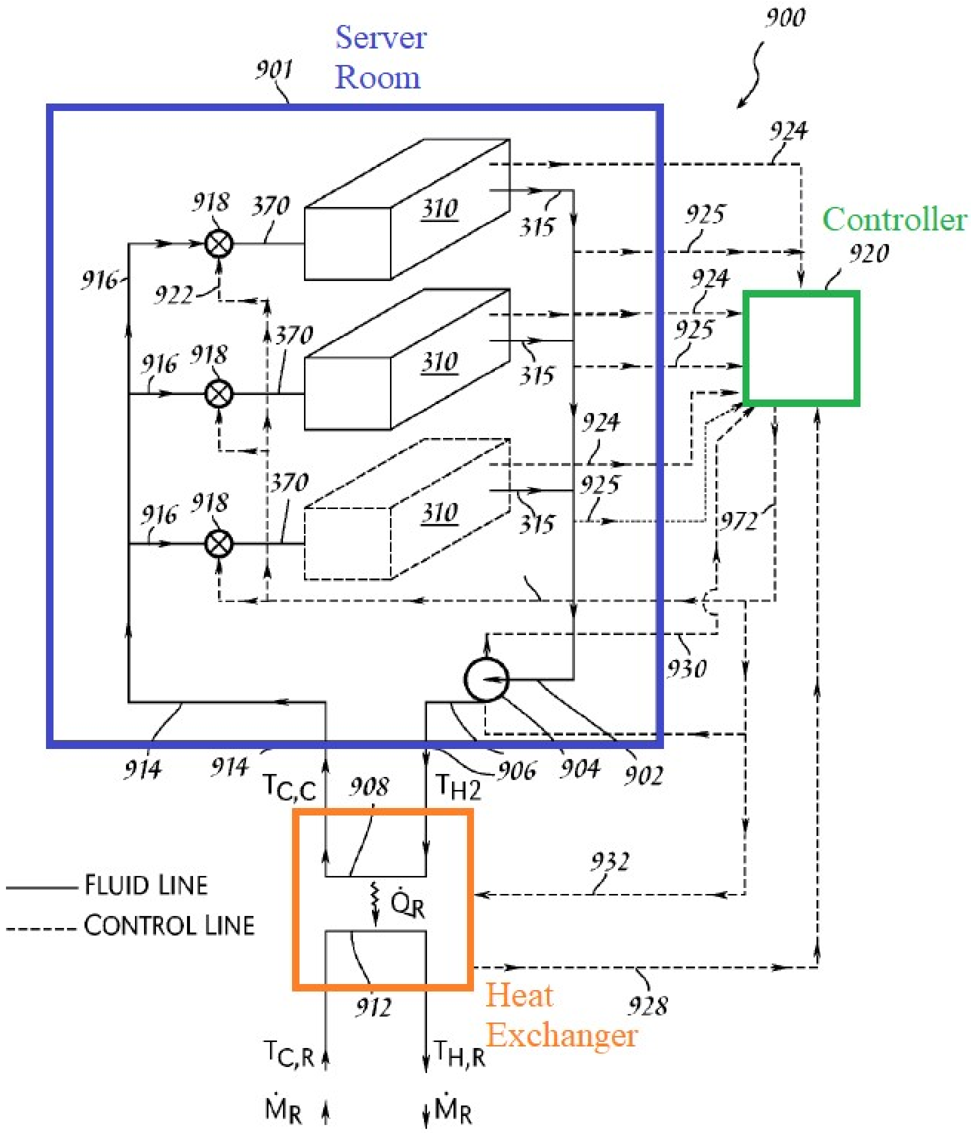


Fig. 15

(Ex-1004-Best-2008 at FIG. 15; 0049, 0120 (explaining FIG. 15 depicts "a system for cooling multiple immersion-cooled server racks…located in a server room of a typical data center); 0030 (explaining a server room is connected to a heat exchanger "distally located" from the server room); 0123 (explaining controller 920 "operates an application program that processes the information received from the various

monitoring signals to selected an optimum elevated temperature, the energy needed to be rejected by the system to cool the servers and maintain the elevated temperature, and then determine the various settings of the system 900 components that will be needed to maintain the elevated temperature of the liquid coolant exiting the servers in the multiple server racks 310"); 0121-22, 0124-25 (detailing additional controller 920 functionality relative to the server room embodiment of FIG. 15). Accordingly, Best-2008, teaches and renders obvious a "communication facility adapted to facilitate monitoring and control of the control facility from a remote location." (Ex-1003-Dahm at ¶¶236-240.) Indeed, there is nothing inventive about remotely monitoring/controlling common components of a fluid recirculation facility. (*Id.* at ¶235.)

Thus, Best-2008 teaches this limitation and Best-2008 in view of Osada renders obvious claim 5.

2. Claim Sets 2-3

As shown in Ex-1009, reproduced below, there are no material differences between claims 1-5 and claims 6-10 (claim set 2) and claims 11-16 (claim set 3). (Ex-1003-Dahm at ¶¶154-155.)

The "tank module" of the preambles of claims 6-16 recites an intended use and, therefore, is not limiting. In any event, the prior art cited herein discloses and

renders obvious "tank modules" for use in "appliance immersion cooling systems" as claims 1-5 show. (Ex-1003-Dahm at ¶156.)

Claim 15 recites an "appliance immersion cooling system comprising a tank module according to any one of the preceding claims 11 through 14." This claim is non-sensical as claim 11 already recites "*A tank module* (10) adapted for use in *an appliance immersion cooling system*," but in any event the prior art cited herein discloses and renders obvious tank modules used in appliance immersion cooling systems, as claims 1-5 show. (Ex-1003-Dahm at ¶157.)

Thus, Best-2008 in view of Osada renders obvious claims 6-16 for the reasons provided above. (Ex-1003-Dahm at ¶¶241-263.)

Comparison of '457 patent claims

Claim Set 1 (claims 1-5)	Claim Set 2 (claims 6-10)	Claim Set 3 (claims 11-16)
[1.0] An appliance immersion cooling system comprising:	[6.0] A *tank module adapted for use in* an appliance immersion cooling system, *the tank module* comprising:	[11.0] *A tank module (10) adapted for use in* an appliance immersion cooling system, *the tank module* comprising:
[1.1] a tank adapted to immerse in a dielectric fluid a plurality of electrical appliances, each in a respective appliance slot distributed vertically along, and extending transverse to, a long wall of the tank, the tank comprising:	[6.1] a tank adapted to immerse in a dielectric fluid a plurality of electrical appliances, each in a respective appliance slot distributed vertically along, and extending transverse to, a long wall of the tank, the tank comprising:	[11.1] a tank (12) adapted to immerse in a dielectric fluid a plurality of electrical appliances (16), each in a respective appliance slot (18) distributed vertically along, and extending transverse to, a long wall

Claim Set 1 (claims 1-5)	**Claim Set 2 (claims 6-10)**	**Claim Set 3 (claims 11-16)**
		of the tank (10), the tank (10) comprising:
[1.2] a weir, integrated horizontally into the long wall of the tank adjacent all appliance slots, *<u>having an overflow lip</u>* adapted to facilitate substantially uniform recovery of the dielectric fluid flowing through each appliance slot; and;	[6.2] a weir, integrated horizontally into the long wall of the tank adjacent all appliance slots, *<u>having an overflow lip</u>* adapted to facilitate substantially uniform recovery of the dielectric fluid flowing through each appliance slot; and;	[11.2] a weir 22, integrated horizontally into the long wall of the tank (10) adjacent all appliance slots (18), adapted to facilitate substantially uniform recovery of the dielectric fluid flowing through each appliance slot (18);
[1.3] a dielectric fluid recovery reservoir positioned vertically beneath the overflow lip of the weir and adapted to receive the dielectric fluid as it flows over the weir;	[6.3] a dielectric fluid recovery reservoir positioned vertically beneath the overflow lip of the weir and adapted to receive the dielectric fluid as it flows over the weir;	N/A
[1.4] a primary circulation facility adapted to circulate the dielectric fluid through the tank, comprising: a plenum, positioned adjacent the bottom of the tank, adapted to dispense the dielectric fluid substantially uniformly upwardly through each appliance slot;	[6.4] a primary circulation facility adapted to circulate the dielectric fluid through the tank, comprising: a plenum, positioned adjacent the bottom of the tank, adapted to dispense the dielectric fluid substantially uniformly upwardly through each appliance slot; *<u>and</u>*	[11.3] a primary circulation facility (28) adapted to circulate the dielectric fluid through the tank (10), comprising: a plenum (36), positioned adjacent the bottom of the tank (10), adapted to dispense the dielectric fluid substantially uniformly upwardly through each appliance slot (18); and
[1.5] a secondary fluid circulation facility adapted to extract heat	N/A	*See* Claim 16

Claim Set 1 (claims 1-5)	**Claim Set 2 (claims 6-10)**	**Claim Set 3 (claims 11-16)**
from the dielectric fluid circulating in the primary circulation facility, and to dissipate to the environment the heat so extracted; *and*		
[1.6] a control facility adapted to coordinate the operation of the primary and secondary fluid circulation facilities as a function of the temperature of the dielectric fluid in the tank.	[6.5] a control facility adapted to control the operation of the primary fluid circulation facility as a function of the temperature of the dielectric fluid in the tank.	[11.4] a control facility (58) adapted to control the operation of the primary fluid circulation facility (28) as a function of the temperature of the dielectric fluid in the tank (10).
2. The system of claim 1 wherein the tank and primary circulation facility comprise a highly-integrated module.	7. The *module of claim 6* wherein the tank and primary circulation facility comprise a highly-integrated module.	N/A
3. The system of claim 1 wherein the tank further comprises:	8. The *module of claim 6* wherein the tank further comprises:	12. The *tank module of claim 11* wherein the tank further comprises:
an interconnect panel facility adapted to mount appliance support equipment.	an interconnect panel facility adapted to mount appliance support equipment.	an interconnect panel facility (24) adapted to mount appliance support equipment.
4. The system of claim 1 wherein the primary circulation facility further comprises:	9. The *module of claim 6* wherein the primary circulation facility further comprises:	13. The *module of claim 11* wherein the primary circulation facility further comprises:
at least first and second primary circulation sub-	at least first and second primary circulation sub-	at least first and second primary circulation sub-

Claim Set 1 (claims 1-5)	**Claim Set 2 (claims 6-10)**	**Claim Set 3 (claims 11-16)**
facilities, each adapted to operate independently to circulate the dielectric fluid through the tank;	facilities, each adapted to operate independently to circulate the dielectric fluid through the tank;	facilities (28a, 28b), each adapted to operate independently to circulate the dielectric fluid through the tank;
wherein the control facility is further adapted to coordinate the operation of the first and second primary circulation sub-facilities <u>and the secondary fluid circulation facilities</u> so to maintain the temperature of the dielectric fluid in the tank substantially between a predetermined minimum temperature and a predetermined maximum temperature.	wherein the control facility is further adapted to coordinate the operation of the first and second primary circulation sub-facilities so to maintain the temperature of the dielectric fluid in the tank substantially between a predetermined minimum temperature and a predetermined maximum temperature.	wherein the control facility is further adapted to coordinate the operation of the first and second primary circulation sub-facilities so to maintain the temperature of the dielectric fluid in the tank substantially between a predetermined minimum temperature and a predetermined maximum temperature.
5. The system of claim 1 wherein the control facility further comprises a communication facility adapted to facilitate monitoring and control of the control facility from a remote location.	10. The <u>*module of claim 6*</u> wherein the control facility further comprises a communication facility adapted to facilitate monitoring and control of the control facility from a remote location.	14. The <u>*module of claim 11*</u> wherein the control facility further comprises a communication facility (62, 64) adapted to facilitate monitoring and control of the control facility from a remote location.
N/A	N/A	15. An appliance immersion cooling system comprising a tank module according to any one of the preceding claims 11 through 14.

Claim Set 1 (claims 1-5)	Claim Set 2 (claims 6-10)	Claim Set 3 (claims 11-16)
See claim 1	N/A	16. An appliance immersion cooling system according to claim 15, further comprising:
See claim 1	N/A	a secondary fluid circulation facility adapted to extract heat from the dielectric fluid circulating in the primary circulation facility, and to dissipate to the environment the heat so extracted.

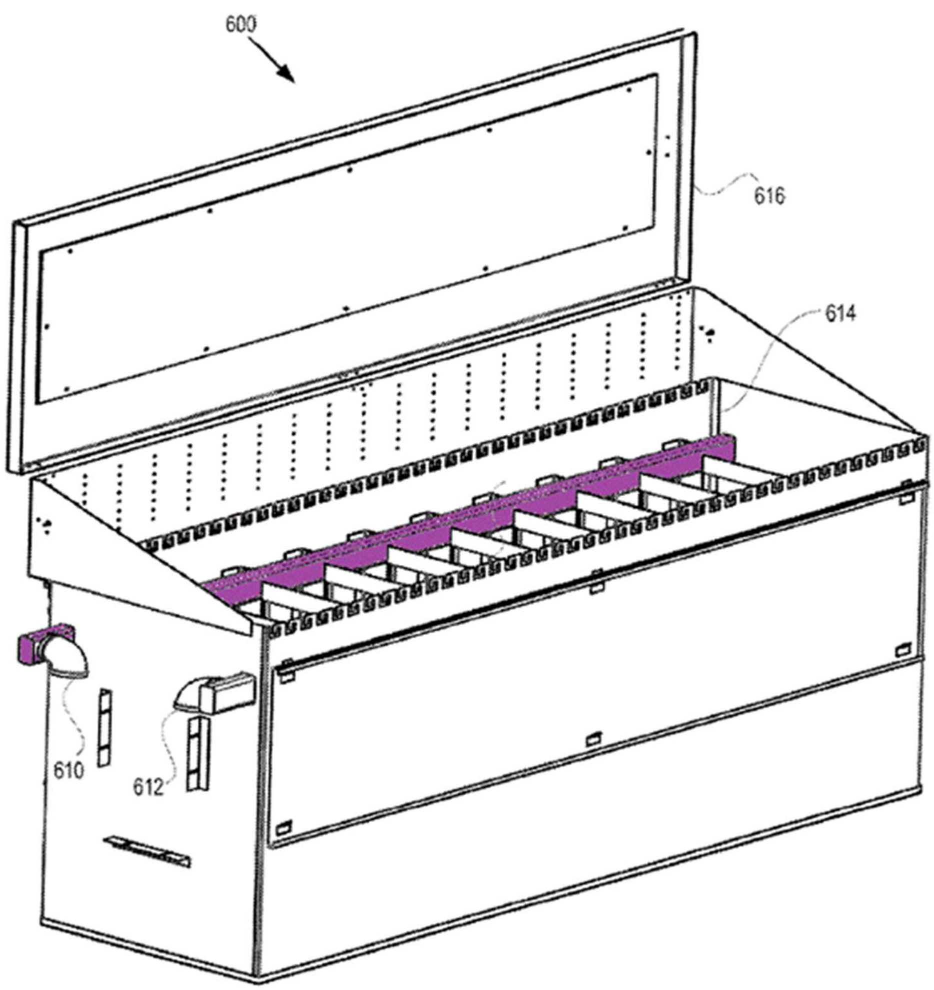
XI. GROUND 2: Best-2008 in view of Osada and Best-2012

A. Scope, Content, and Rationale for Combining Prior Art

Ground 2 relies on Best-2008, Osada, and Best-2012.

As shown in Ground 1, the combination of Best-2008 and Osada renders obvious "a weir, integrated horizontally into the long wall of the tank *adjacent all appliance slots*, having an overflow lip adapted to facilitate substantially uniform recovery of the dielectric fluid flowing through each appliance slot." Best-2012 confirms it was obvious for Osada's weir-and-notches arrangement to be implemented in Best-2008's tank "adjacent all appliance slots." (Ex-1003-Dahm at ¶¶264-265.)

Specifically, Best-2012 is a later patent application filed by the inventor of Best-2008 (Christiaan Best) including updated designs for its dielectric tank. One of the updates relates to the use of a manifold (purple) that extends along the entirety of the long wall of the tank:



(Ex-1006-Best-2012 at FIG. 6; Ex-1003-Dahm at ¶¶266-267.)

The manifold (720) is "attached to the coolant outlet 610 inside the interior volume of the tank 600" and has "*a plurality of nozzles or velocity augmentation devices* of area A_2 ***distributed along [its] length***. (Ex-1006-Best-2012 at 0069.)

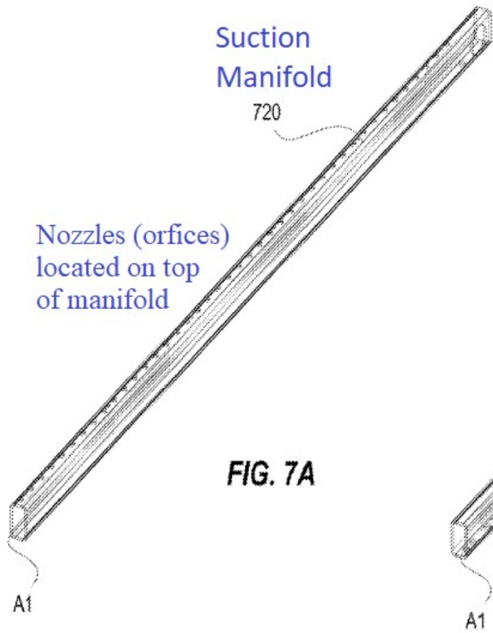


FIG. 7A

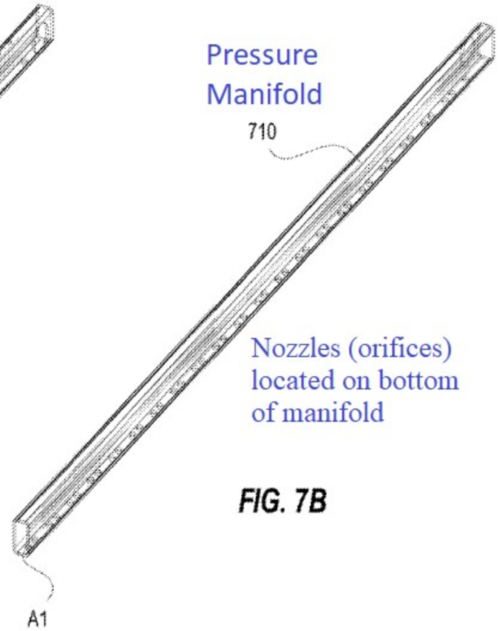


FIG. 7B

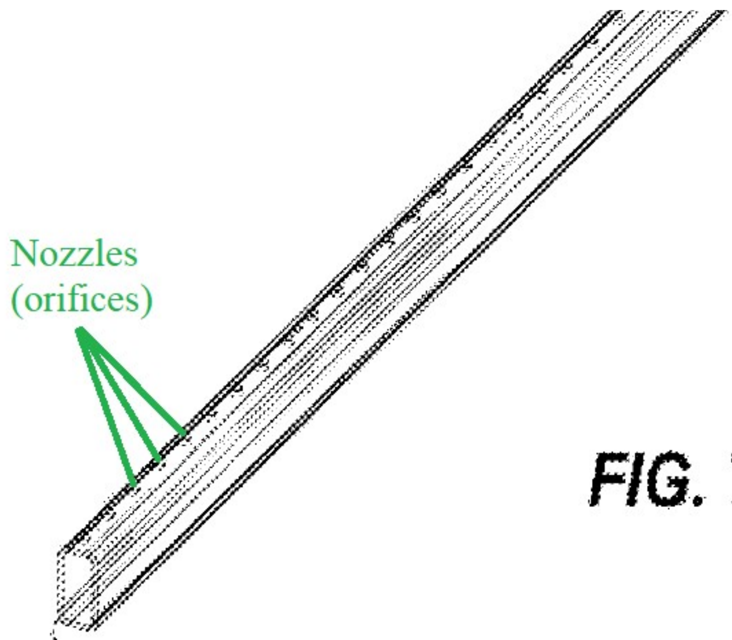
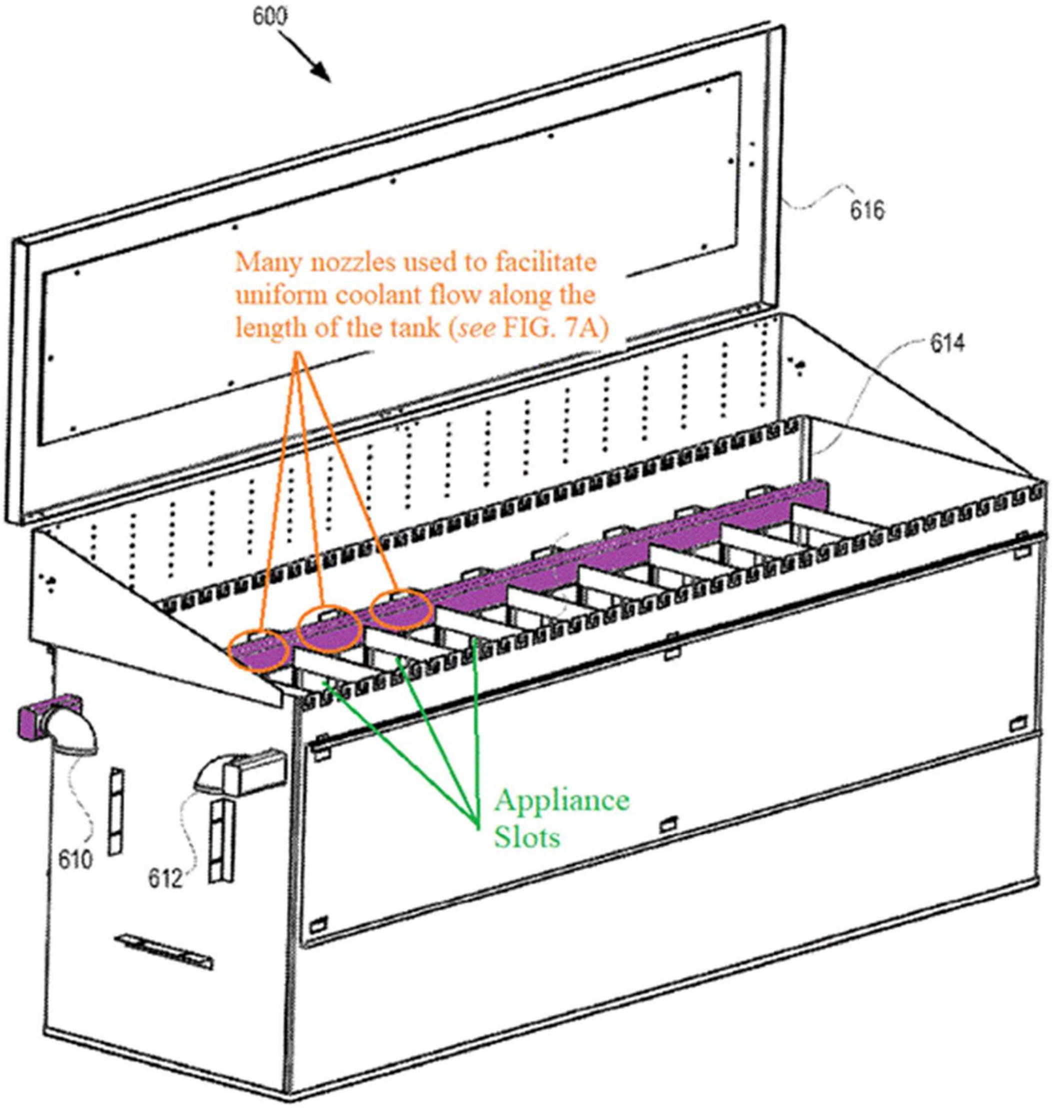


FIG. 7A

(*Id.* at FIGS. 7A-7B; Ex-1003-Dahm at ¶¶268, 270.)[14] As shown, the nozzles/orifices are illustrated as being located uniformly across the entire upper surface of the suction manifold, and a POSITA would recognize from these drawings that such nozzles/orifices are located "adjacent all appliance slots" in the Best-2012 tank:

[14] Dr. Dahm confirms that, given the illustrations and descriptions of Best-2012 relating to FIGS. 6 and 7A-7B, a POSITA would have understood the manifolds of Best-2012 to include orifices (apertures or holes) to allow the fluid to exit or enter such manifolds, and such orifices correspond to the "nozzles" described by Best-2012. (Ex-1003-Dahm at ¶269 citing Ex-1022 (showing a POSITA interchangeably uses the term "orifices" and "nozzles" in contexts similar to the manifolds of Best-2012, and showing simple "straight" orifices (holes) are considered to be "nozzles.").)



(Ex-1003-Dahm at ¶271; Ex-1006-Best-2012 at FIG. 6.) Best-2012 explains that this arrangement is beneficial for creating uniform coolant flow through the tank:

> "The area [] of the velocity augmentation devices along the length of the pressure manifold 710 is much smaller than the area [] of the pressure manifold 710. This allows for the pressure lost through the velocity augmentation devices to be much greater than the pressure lost through the pressure manifold 710. *Consequently, the pressure across the velocity augmentation devices is approximately equal*

> *over the entire length of the tank 600. Likewise, suction across the suction manifold 720 is approximately equal along the entire length of the tank 600.* ***Hence, coolant flow is approximately equal along the length of the entire tank 600***." (*Id.* at 0070.)

Thus, Best-2012 teaches a POSITA that dielectric liquid should be extracted from the tank by using a mechanical structure (e.g., a manifold having nozzles/orifices, or other velocity augmentation devices) located along the long wall of the tank. (Ex-1003-Dahm at ¶¶272-273.)

A POSITA would have been motivated to apply the manifold teachings of Best-2012 to Best-2008 and Osada. As explained in Ground 1, Best-2008 already desires to achieve uniform coolant flow through its servers and between server slots, and the teachings of Best-2012 align with that purpose. Moreover, as also explained in Ground 1, it was obvious to use Osada's weir-and-notches teachings with Best-2008, and Best-2012 shows that Osada's notches should be implemented in Best-2008's tank "adjacent all appliance slots," just like the nozzles of Best-2012, to achieve "coolant flow [that] is approximately equal along the length of the entire tank 600." (Ex-1006-Best-2012 at 0070; Ex-1003-Dahm at ¶¶274-276.)

A POSITA also would have had a reasonable expectation of success in implementing the teachings of Best-2012 with Best-2008 and Osada. As described in Ground 1, it was simple to implement Osada's weir-and-notches teachings with

Best-2008 and Best-2012 merely confirms the placement of Osada's notches. (Ex-1003-Dahm at ¶¶277-278.)

B. Challenged Claims

Ground 2 challenges all claims 1-16. As in Ground 1, Petitioner first addresses claims 1-5 (the first claim set), with the second and third claim sets (claims 6-10 and 11-16) addressed thereafter.

1. Claim Set 1

[1.0-1.1]

Best-2008 discloses these limitations for the reasons provided in Ground 1. (Ex-1003-Dahm at ¶¶279-280.)

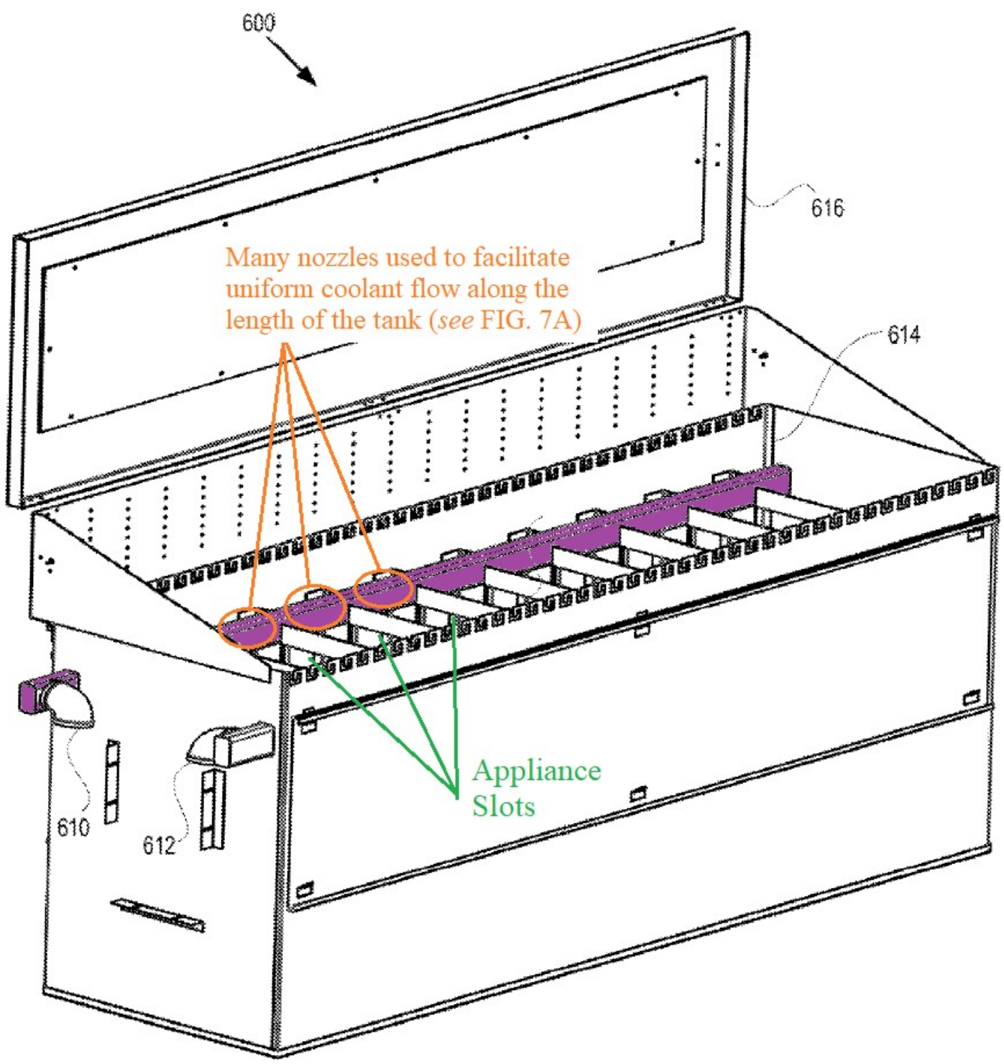
[1.2] "a weir, integrated horizontally into the long wall of the tank adjacent all appliance slots, having an overflow lip adapted to facilitate substantially uniform recovery of the dielectric fluid flowing through each appliance slot; and"

Best-2008 in view of Osada and Best-2012 teaches this limitation.

As explained in Ground 1, it was obvious to implement Osada's weir-and-notches teachings with Best-2008, which discloses "a weir, integrated horizontally into the long wall of the tank… having an overflow lip adapted to facilitate substantially uniform recovery of the dielectric fluid flowing through each appliance slot." (Ex-1003-Dahm at ¶281.)

Osada discloses that its weir-and-notches arrangement should preferably "provide *multiple notches over a broad range*, and it is even more preferable to

provide these notches *at uniform spacing* to ensure that it is possible *to force the flow of all of the floating impurities* that are easily suspended on the liquid surface and impurities that are more likely to be suspended in the lower layers *into the overflow box over the entirety of the liquid in the liquid tank*." (Ex-1005-Osada at 0018.) Best-2012 shows that Osada's notches should be uniformly spaced and located adjacent each appliance slot to facilitate uniform "coolant flow…along the length of the entire tank 600:"



(Ex-1006-Best-2012 at 0070, FIG. 6; Ex-1003-Dahm at ¶¶282-285.)

Thus, Best-2008 in view of Osada and Best-2012 teaches this limitation.

[1.3-1.6]

Best-2008 in view of Osada teaches these limitations for the reasons provided in Ground 1, and Best-2008 in view of Osada and Best-2012 render obvious claim 1. (Ex-1003-Dahm at ¶286.)

[Claim 2-5]

Best-2008 in view of Osada teaches these limitations for the reasons provided in Ground 1. Thus, Best-2008 in view of Osada and Best-2012 renders obvious claims 2-5. (Ex-1003-Dahm at ¶287.)

2. Claim Sets 2-3

As explained in Ground 1, there are no material differences between claims 1-5 and claims 6-10 (claim set 2) and claims 11-16 (claim set 3), and, therefore, those claims are obvious for the same reasons provided above relative to claims 1-5 in Ground 2. (Ex-1003-Dahm at ¶¶288-308.)

XII. CONCLUSION

For the foregoing reasons, Petitioner respectfully requests cancellation of claims 1-16.

Respectfully submitted,
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Date: November 19, 2024

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CERTIFICATE OF SERVICE

The undersigned certifies that a true and correct copy of the Petition together with all exhibits identified in the above Table of Exhibits and Petitioner's Power of Attorney, have been served on the Patentee via Priority Mail Express or by means at least as fast and reliable as Priority Mail Express on the below date, at the following address:

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